DRAKE

R8/R8E Communications Receiver

Service Manual

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Addendum

This **second printing** of the R8/R8E Service manual contains updates to the following assemblies as noted. A keypad switch matrix diagram is also added (page 52).

REF	PART NUM	DESCRIPTION
1) FRONT END BOARD		
ADDITIONS		
R184 5.6K	3220215	RES C. FILM 5.6K, 5%, 1/4W
C258 12pF CHIP	3167507	CAP CHIP 12pF NPO 0805
DELETIONS		
R134 4.7K	3220210	RES C. FILM 4.7K, 5%, 1/4W
R155 4.7M	3220370	RES C. FILM 4.7M, 5%, 1/4W
CR122 1N4148	3220090	DIODE, SILICON
L130	2510082	INDUCTOR, TOROID RLD DWG B4007-46
L131	3524119	COIL, VAR 0.80µH 7MM RLD DWG B8048-4
L132	3524119	COIL, VAR 0.80µH 7MM RLD DWG B8048-4
C160 4-20pF	3205207	CAP VAR TRIMMER
C163 9pF CHIP	3166144	CAP CHIP 9pF NPO 0805
C165 9pF CHIP	3166144	CAP CHIP 9pF NPO 0805
C161 .001uF	3151405	CAP AXIAL .001MF 10% Y5P
CHANGES		
R143 10K (WAS 6.8K)	3220235	RES C. FILM 10K, 5%, 1/4W
R135 1M (WAS 100K)	3220355	RES C. FILM 1 MEG, 5%, 1/4W
L138	2510103 (WAS 2510082)	
L140	2510104 (WAS 2510022)	
C162 2.2pF (WAS 3.9pF)	3166136	CAP CHIP 2.2pF 50V 0805
C164 2.2pF (WAS 3.9pF)	3166136	CAP CHIP 2.2pF 50V 0805
R173 270 (WAS 390)	3220085	RES C. FILM 270, 5%, 1/4W
Q102 3SK81 (WAS 3N204)	3030286	TRANSISTOR DUAL GATE MOSFET 3SK81
2) 2ND IF/AUDIO BOARD		
ADDITIONS		
C361 .01uF	3151515	CAP AXIAL .01MF 20% Y5P
SHIELD	4560254	SHIELD POT CORE RLD DWG B8297
R384	3220330	RES C. FILM 220K, 5%, 1/4W
R385	3220145	RES C. FILM 820, 5%, 1/4W
R386	3220350	RES C. FILM 680K, 5%, 1/4W
R387	3220315	RES C. FILM 100K, 5%, 1/4W
C359	3151259	CAP AXIAL 220Pf, 10%, Y5P
C360	3151405	CAP AXIAL .001MF, 10%, Y5P
DELETIONS		
C291 91pF.	3151050	CAP AXIAL 91pF, 2%, NPO
CHANGES		
R327 5.1K (WAS 6.8K)	3220212	RES C. FILM 5.1K, 5%, 1/4W
R345 2.2K (WAS 3.3K)	3220190	RES C. FILM 2.2K, 5%, 1/4W
R375 120K (WAS 180K)	3220317	RES C. FILM 120K, 5%, 1/4W
R387 100K (WAS 150K)	3220315	RES C. FILM 100K, 5%, 1/4W
C257 68pF (WAS 100pF)	3150900	CAP AXIAL 68pF, 2%, NPO
3) SYNTHESIZER BOARD		
ADDITIONS		
R405 220	3220075	RES C. FILM 220 OHM, 5%, 1/4W
R406 220	3220075	RES C. FILM 220 OHM, 5% 1/4W
C418 56pF NPO	3150896	CAP AXIAL 56pF, 5%, NPO
DELETIONS		
R407 10K	3220235	RES C. FILM 10k, 5%, 1/4W
CHANGES		
U106 VERSION 12 SOFTWARE	4671318	I.C. 27256 E PROM W/VERSION 12 R8 SOFTWARE
R348 10K POT (WAS 20K)	3260664	RES VAR PT 10V 10K

SAFETY INSTRUCTIONS

SAFETY PRECAUTION

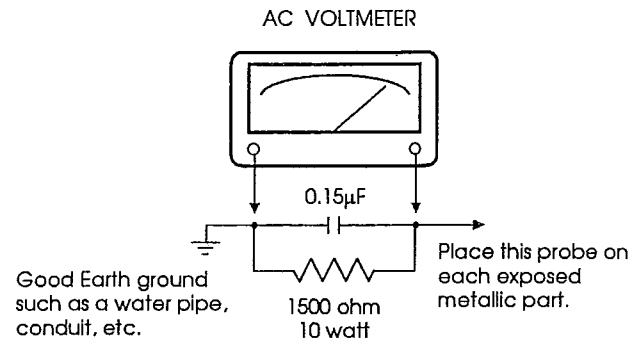
WARNING: Service should not be attempted by anyone unfamiliar with the necessary precautions on this unit.

The following are the necessary precautions to be observed before servicing this chassis.

1. When replacing a chassis in the cabinet, always be certain that all the protective devices are put back in place. Examples of these items are: non-metallic control knobs, insulating covers, shields, and isolation resistor-capacitor networks etc.

2. Before returning the set to the customer, always perform an AC leakage current check on the exposed metallic parts of the cabinet, as well as antennas, terminals, screw-heads, metal overlays, control shafts etc. Be sure the set is safe to operate without danger of electric shock. Plug the AC line cord directly into the 120V AC outlet (do not use a line isolation transformer during this check). Use an AC voltmeter having 5000 ohms per volt or more sensitivity in the following manner:

Connect a 1500 ohm, 10 watt resistor, paralleled by a 0.15 mF, AC type capacitor, between a known good earth ground (water pipe, conduit, etc.) and the exposed metallic parts, one at a time. Measure the AC voltage across the combination of 1500 ohms resistor and 0.15 mF capacitor, reverse the AC plug at the AC outlet and repeat AC voltage measurements for each exposed metallic part. Voltage measured must not exceed 0.3 volts RMS. This corresponds to 0.2 milliamp AC. Any value exceeding this limit constitutes a potential shock hazard and must be corrected immediately.


AC VOLTMETER
0.15µF
Good Earth ground such as a water pipe, conduit, etc.
1500 ohm 10 watt
Place this probe on each exposed metallic part.

PRODUCT SAFETY NOTICE

Many electrical and mechanical parts in this chassis have special safety-related characteristics. These characteristics are often passed unnoticed by a visual inspection and the protection afforded by them cannot necessarily be obtained by using replacement components rated for higher voltage, wattage, etc. Replacement parts with these safety characteristics are identified in this manual and are shaded on the schematics.

Before replacing any of these components, read the parts list in this manual carefully. The use of substitute replacement parts which do not have the same safety characteristics as specified in the parts list may create shock, fire, or other hazards.

BEFORE ATTEMPTING SERVICE

CAUTION: UNPLUG RECEIVER'S POWER CORD BEFORE PLUGGING IN CABLES ON PRINTED CIRCUIT BOARDS AND OTHER COMPONENTS, THEN DOUBLE CHECK FOR CORRECT CABLE POSITIONING BEFORE APPLYING POWER.

EVEN A MOMENTARY IMPROPER CABLE CONNECTION TO PRINTED CIRCUIT BOARDS OR OTHER COMPONENTS CAN CAUSE WIDE SPREAD DAMAGE TO INTEGRATED CIRCUITS AND DISCRETE COMPONENTS. NOTE: CABLES ARE NOT KEYED IN ALL CASES TO PREVENT IMPROPER INSERTION.

POWER MUST BE DISCONNECTED FROM RECEIVER'S POWER CORD TO PREVENT POSSIBLE DAMAGE WHEN INSERTING CABLES SINCE MANY CIRCUITS REMAIN OPERATIVE WHEN THE POWER BUTTON IS "OFF." ALWAYS DOUBLE CHECK FOR CORRECT CABLE POSITIONING BEFORE APPLYING POWER.

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USING THE R8/R8E SERVICE MANUAL

This manual is divided into several sections for clarity and ease of use. Each major section is written with the assumption that the preceeding portions of the manual have been read and understood by the user.

Section 1 is introductory in nature, and provides a general discussion of operating theory and module location.

Section 2 contains complete information on each functional element of the R8/R8E. This information includes detailed circuit description, parts list, component location and schematic diagram. This section of the manual is divided by major functional element such as circuit board, module chassis, etc. for the purpose of rapid circuit, component and problem identification.

Section 3 is a complete alignment procedure for the R8/R8E, and includes test equipment requirements/recommendations and test point locations.

Section 4 includes a complete description of any available R8/R8E accessories, including circuit descriptions, pictorials and schematics.

LOCATING A MALFUNCTION

The design of the R8/R8E permits access to the Synthesizer board by removing only the bottom cover of the receiver. The Synthesizer board contains all the reference frequency generation and the entire microprocessor/digital control of the receiver. The Front End board is accessible by removing the top cover of the receiver. The Front End board contains all circuitry that converts the input signal to the 50 KHz IF prior to the main selectivity and audio detection. The FM detection circuitry is also contained on this board. The 2nd IF/Audio board is located immediately below the Front End board. It is accessible by securing the Front End board in a vertical position near the rear of the R8/R8E by positioning the routed tabs on the board into the slots provided on the top surface of the rear panel metal chassis. Note that cabling to the Front End board is designed to permit full electrical operation of the R8/R8E with the board temporarily positioned vertically. The Front Panel board is accessible by hinging the front panel down by removal of the top two screws securing the panel to the subpanel and loosening the lower two screws. Interconnection from board to board or control-to-board is with use of either flexible ribbon cable or flexible wire cable. RF signal interconnects are accomplished using coaxial pin and shield cables that mate to a board mounted coaxial connector at each termination end. Thus boards can be removed for part replacement if necessary and easily replaced for testing.

The first step in troubleshooting the R8/R8E should be isolation of the malfunction to the major board level. Refer to the **"Generalized Theory of Operation Section"** for a general discussion of theory of operation and determine which circuit board and specific section of that board would cause the problem at hand. In most cases, the problem will involve only one of the four major boards.

Once the problem has been isolated, refer to the appropriate portion of Section 2 for a full scale description of the circuit.

GENERALIZED THEORY OF OPERATION

Receiver Section

Incoming signals from antenna 1, antenna 2, and converter receptacles are first routed through the antenna switch module. The 50/500 Ohm antenna 2 input is matched with a 9:1 transformer prior to being routed to the antenna switch module.

The output of this module is followed by a selectable attenuator providing 10 dB of attenuation when enabled.

The signal is then sent to a 9 band, pin diode switched, bandpass filter network.

The bandpass filter output is routed through a selectable preamplifier providing a nominal 10 dB of gain when enabled. The output of the preamp is then supplied to a master lowpass filter which serves to attenuate signals above 30 MHz. The signal is then mixed with the 45.1-75 MHz 1st local oscillator (LO) to create a 45 MHz 1st intermediate frequency (IF) signal. Conversion is accomplished by a standard-level, double-balanced mixer (DBM) to provide wide dynamic range. The output of the DBM is then amplified by a low-noise, high dynamic range junction FET amplifier to insure proper receiver sensitivity. This stage is followed by a 4-pole, monolithic 45 MHz crystal filter. The purpose of this filter is to attenuate signals more than ± 6 KHz removed from the 45 MHz IF center frequency, thus protecting the remaining stages of the receiver from strong adjacent signals yet permitting sufficient bandwidth for proper narrow-band FM reception. In this manner, optimum receiver dynamic range is preserved while providing proper sensitivity.

The output of the crystal filter is then split between the FM detector circuitry and the remaining 45 MHz IF circuitry.

When the FM mode is operational, the 45 MHz 1st IF signal is demodulated by a dual conversion FM detector integrated circuit. The detected RF level is used to control an audio squelch gate. The recovered audio is routed through the squelch gate to the audio amplifier stage.

In the remaining AM, CW, RTTY, LSB, and USB modes, the signal is amplified by a tuned, dual-gate FET amplifier to which automatic gain control (AGC) voltage is also applied. The output of this amplifier stage is then routed to the image reject mixer (IRM) which converts the 45 MHz 1st IF frequency to the 50 KHz 2nd IF frequency while simultaneously helping to further suppress the image response attenuation provided by the crystal filter. The IRM uses a 45.05 MHz +/- 3 KHz LO frequency to accomplish the conversion of the 45 MHz IF signal to the 50 KHz 2nd IF signal.

The 50 KHz 2nd IF signal is then applied to the main IF circuitry. The first stage of the IF is a dual-gate FET to which AGC voltage is applied. The output of this amplifier is routed to the noise blanker circuit. When activated, the noise blanker acts on short duration noise pulses removing them before they reach the 50 KHz bandpass filters which would cause the pulses to be stretched thus rendering the blanker ineffective.

Following the noise blanker is the first of two 4-pole bandpass filter networks which provide a cascaded 8-pole response. An amplifier between the first 4-pole and second 4-pole provides another stage of AGC controlled gain as well as impedance matching for the filter sections. The two filter networks are electronically switched to provide the 6.0, 4.0, 2.3, 1.8, and 0.5 KHz IF bandwidths. Following the IF selectivity, the signal is further amplified by one last dual-gate FET which is also AGC controlled, before being demodulated either by a product detector for USB, LSB, CW, RTTY, and AM or an AM synchronous detector. The product detector utilizes a locally generated 50 KHz beat frequency oscillator (BFO) carrier that tracks with the 2nd LO. The synchronous detector generates a synthesized 50 KHz carrier that is locked to the received AM carrier. The loop time constant is sufficiently long to maintain the 50 KHz carrier during periods when the received AM signal fades.

Once detected, the recovered audio is routed to the noise blanker. As noise bursts are detected on the 50 KHz IF signal, the IF signal is turned off for the duration of the pulse. The audio is routed through the noise blanker so that the audio signal level is held at a constant level for the duration of the noise pulse. The audio is then applied to a tone control circuit which provides ± 10 dB of bass boost and bass cut as the front panel tone control is rotated to its extremes. Following the tone control, the audio is applied to the notch circuit. Audio frequencies from 500 Hz to 5 KHz are nulled by summing the audio with a 180° phase shifted and bandpassed-audio signal. The notch is disabled by turning off the bandpass filter section of the circuit.

Following the tone and notch circuits, the audio is routed to the squelch gate. The squelch reference for all modes (including FM) is the buffered AGC line with the squelch trip point set via the front panel squelch control.

The unsquelched audio is then sent to a buffer and 5 KHz lowpass filter. From this point audio is routed to two buffered line audio outputs and also to the volume control which feeds the audio power amplifier for the speaker. The output of the power amplifier passes through the headphone jack before switching between the internal and/or external speaker(s).

AGC voltage, developed prior to the demodulation, is used to control the gain of the IF stages. The same AGC signal is used to drive the S-meter circuit to provide accurate received signal strength indication. AGC decay time constants are electronically selected by front panel and microprocessor control.

FREQUENCY CONTROL

The R8/R8E features synthesizer control of the received frequency. This allows the receiver to cover a wide frequency range without the use of range crystals or other frequency determining elements.

The reference for the synthesizer is generated by a 35 MHz crystal oscillator on the synthesizer board. This reference is used by each of three nested phase locked loops which operate over the range of 45.1 - 75.0 MHz to provide a first local oscillator signal. When this first local oscillator output is mixed with 100 KHz (150 KHz for R8E) to 30 MHz incoming signals, the result is a 45 MHz 1st IF frequency. Additionally, the 35 MHz reference is used in each loop to mix or translate signals to the appropriate frequencies. In the PLL 1 loop, the 35 MHz reference is used to translate the ouput of the PLL 2 loop from 6.0 MHz to 41.0 MHz. Similarly, the 35 MHz reference is doubled to produce 70 MHz which is used in PLL 2 and PLL 3 loops to translate signals. The 35 MHz reference is also divided by 10 to produce a 3.5 MHz reference for the optional VHF Converter board.

The three phase locked loops are nested such that the inner most loop (PLL 3) provides a reference signal to the middle loop (PLL 2). The middle loop in turn provides a reference signal to the outer loop (PLL 1). The inner loop voltage controlled oscillator is divided by 10 from a frequency of approximately 65 MHz to 6.5 MHZ. This 6.5 MHz signal is used to lock PLL 2 on frequency. A 1 KHz frequency step change at 65 MHz becomes a 100 Hz step at 6.5 MHz and the PLL 2 voltage controlled oscillator will change by 100 Hz.

In similar fashion, the PLL 2 voltage controlled oscillator output is divided by 10 from a frequency of approximately 60 MHz to 6.0 MHz. This 6.0 MHz signal is used to lock PLL 1 on frequency. A 10 KHz frequency step change at 60 MHz becomes a 1 KHz step at 6.0 MHz and the PLL 1 voltage controlled oscillator will change by 1 KHz. A frequency step change of 1 KHz in PLL 3 is tracked out, in turn by PLL 2 and then by PLL 1. Thus a 1 KHz frequency step in PLL 3 becomes a 100 Hz step in PLL 2 and a 10 Hz step in PLL 1, the desired minimum frequency step size of the synthesizer output.

Synthesizer load numbers are generated by the microprocessor and sent to each of the three synthesizer loops. The load number is recalculated each time the frequency is changed, either by the front panel keyboard or the main tuning wheel digital encoder. The programmable divider value "N" is thus determined for each synthesizer loop. To cover the range of 45.1 - 75.0 MHz, four individual voltage controlled oscillators actually comprise VCO 1. The respective oscillator ranges are as follows: 45.10000 to 52.49999 MHz, 52.50000 to 59.99999 MHz, 60.00000 to 66.99999 MHz and 67.00000 to 75.00000 MHz. The microprocessor and related circuitry uniquely selects the proper oscillator from one of the four individual oscillators. Within software, the information corresponding to the operating frequency of the receiver is generated and sent to the front panel LCD display.

The passband tuning control is connected to a 22.525 MHz voltage controlled crystal oscillator (VCXO) which is doubled to produce 45.05 MHz. This oscillator is controlled by the front panel PASSBAND OFFSET control and microprocessor digital to analog conversion control which permits manual override of the automatic passband offsets by mode. Although this oscillator is crystal controlled, it is designed to allow its frequency to be moved over a limited range (approximately ± 3 KHz) centered on 45.05 MHz. The 45.05 MHz output is used as the injection for the image reject mixer (IRM) on the Front End board which converts the 45 MHz 1st IF signal to the 50 KHz 2nd IF frequency.

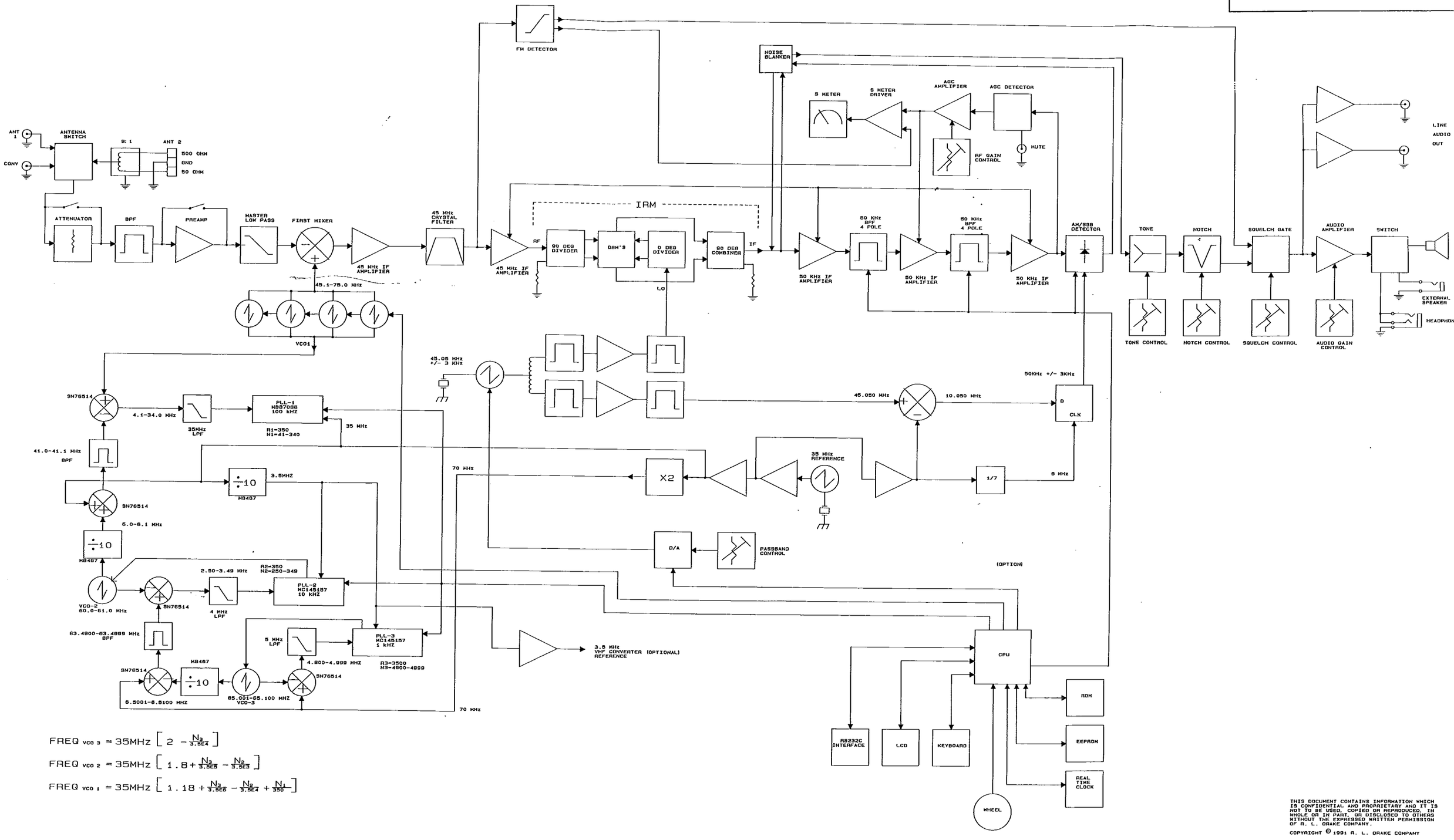
The 45.05 MHz oscillator is also mixed with the 35 MHz reference oscillator to produce a 10.05 MHz signal which is used as one input to a digital mixer. The 35 MHz reference oscillator is divided by 7 to produce a 5 MHz reference which is used as the second input to the digital mixer. The resultant output of the mixer is a 50 KHz IF signal that tunes ± 3 KHz in step with the 45.05 MHz 2nd mixer injection. This 50 KHz signal is used as the BFO to the AM and SSB product detector. Since the 45.05 MHz oscillator is used as the mixer injection which produces the 50 KHz IF signal and BFO, the 45.05 MHz output can be moved in frequency without changing the receiver operating frequency. Therefore, as the 50 KHz BFO is changed (by changing the PASSBAND OFFSET control voltage), the 45.05 MHz injection signal to the IRM is changed by an equal amount. This allows the 50 KHz 2nd IF signal to be positioned anywhere within a ± 3 KHz range with respect to the passband of two cascaded four-pole 50 KHz bandpass filters on the 2nd IF/Audio board while the receiver remains tuned to the incoming signal. This technique provides the PASSBAND OFFSET.

INTERCONNECT DRAWING PARTS LIST

REF	PART NUM	DESCRIPTION
D1	3080034	DISPLAY, LCD
DS1	3470004	LAMP NEON #NE-2E/A9A
E1	3260008	ENCODER WHEEL #600-128
F1	3420127	2A SLO-BLO FUSE
F2	3420258	T400mA FUSE
J1	3281024	JACK PHONE #YKB21-5006
J2	3280011	UHF SO-239 CONNECTOR
J3	3280011	UHF SO-239 CONNECTOR
J7	3301264	2P QUICKCONNECT
KBD1	2055167	8 DIG.KEYBRD-PAD ASSY
KBD2	2055168	18 DIG.KEYBRD-PAD ASSY
MTR1	3581010	"S" METER
R1	3260005	RES VAR AF/RF GAIN 3K/10K
R2	3260006	RES VAR PBT/SQUEL. 10K/10K
R3	3260007	RES VAR TONE/NOTCH 100K
R4	3220055	RES C.FILM 100 OHM 5% 1/4W
R5	3220055	RES C.FILM 100 OHM 5% 1/4W
R6	3220075	RES C.FILM 220 OHM 5% 1/4W
R7	3220215	RES C.FILM 5.6 K 5% 1/4W
R90	3250409	RES COMP 4.7 MEG 10% 1/2W
S1	3670550	SW.VOLT.SELECT #J-R1025-01
SPK1	3640035	SPEAKER 4-OHM #C100K22MO111
T1	3690388	POWER XFMR R8

MISCELLANEOUS CHASSIS PARTS

PART NUMBER	DESCRIPTION
3372503	JUMPER 2-CIRCUIT SHUNT
3390009	FOOT SET
3450001	KNOB TUNING
3450002	KNOB SMALL BOTTOM
3450003	KNOB SMALL TOP TAPERED
3473200	LENS (DIFFUSER) LCD LGT.
3474200	REFLECTOR LGHT.HOUSING
3476001	HOUSING (BOX) LCD LIGHT (HALF)
3712007	CORD, LINE 18/2 76"
3851290	OWNER'S MANUAL
4440595	REAR PANEL SCREENED
4445109	SCREENED FRONT PANEL
4807518	COVER, TOP BLK VINYL
4807550	COVER, BOTTOM



$$FREQ_{VCO\ 3} = 35MHz \left[2 - \frac{N_3}{3.5E4} \right]$$

$$FREQ_{VCO\ 2} = 35MHz \left[1.8 + \frac{N_3}{3.5E5} - \frac{N_2}{3.5E3} \right]$$

$$FREQ_{VCO\ 1} = 35MHz \left[1.18 + \frac{N_3}{3.5E6} - \frac{N_2}{3.5E4} + \frac{N_1}{350} \right]$$

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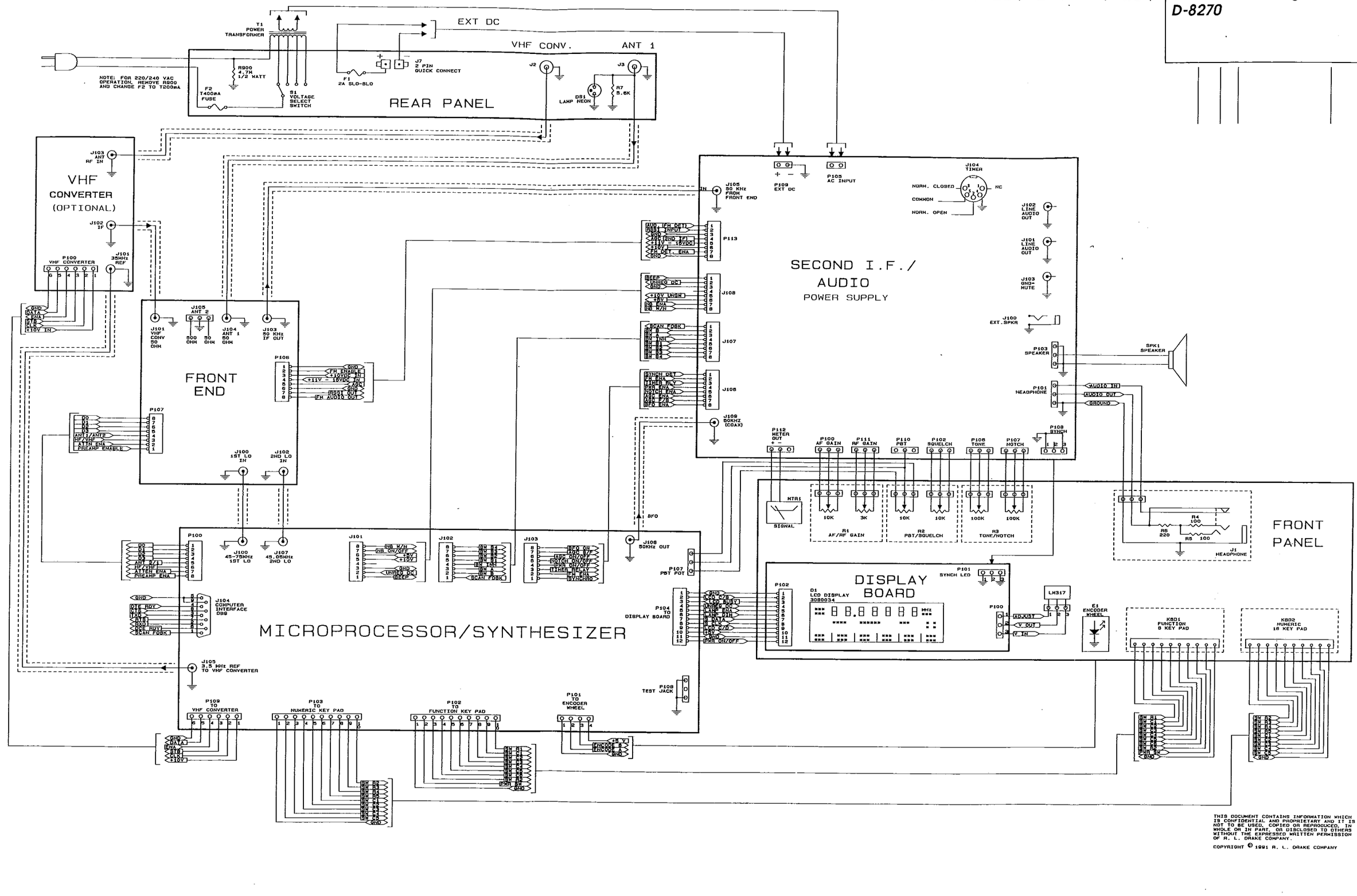

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FRONT END BOARD THEORY OF OPERATION

Incoming signals from the ANT 1 and the converter antenna receptacles are first routed through the antenna switching circuitry consisting of relay RL103 and RL101. ANT 2 is first routed through a 9:1 impedance matching transformer, then to RL103. ANT 1 is selected when both RL101 and RL103 are in the off state. When ANT 2 is selected by the user via the front panel controls, RL103 is energized by Q108 and its associated circuitry. When the converter antenna is selected RL101 is energized by Q107 and its associated circuitry. Both Q107 and Q108 receive their control signals from the microprocessor/synthesizer board via the connector P107.

The signal is then sent through a selectable attenuator which is formed by RL102, R163 and R172. When RL102 is in the off state the attenuator is bypassed. When the attenuator is selected a control signal is sent to Q109 (via connector P107) which energizes RL102 inserting R163 and R172 into the signal path forming a resistive pad providing 10 dB of attenuation. The signal is sent through a 9:1 impedance matching transformer before reaching the bandpass filters. The signal is then routed through 1 of 9 bandpass filters.

The cutoff frequencies of each filter is as follows:

0-0.5 MHz
0.5-1.5 MHz
1.5-2.5 MHz
2.5-4.0 MHz
4.0-7.5 MHz
7.5-10.5 MHz
10.5-15 MHz
15-22 MHz
22-30 MHz

Each bandpass filter has a set of PIN diodes that are normally reversed biased unless the filter is selected. The appropriate filter is automatically selected dependant on the displayed frequency. This is accomplished when U102 (74LS145) receives data from the microprocessor (via connector P107) and selects the appropriate filter by turning on one of its outputs which in turn removes the reverse bias voltage on the selected filter's pin diodes allowing the signal to pass. Following the bandpass filter, the signal is applied to a selectable preamplifier consisting of relay RL100, Q105 (2N5109) and its related circuitry. RL100 is controlled by Q106 and when energized Q105 provides 10 dB of gain when selected.

The preamplifier output is sent through the master low pass before reaching the input of the first mixer. The master low pass filter consists of the following components, C209, C220, C221, C222, C223, C224, C225, L164, L165, and L166.

At the first mixer the incoming signal is mixed with the output of the synthesizer VCO to create a 45 MHz intermediate frequency (IF) signal. The conversion is accomplished by a standard level, double-balanced mixer to provide a high dynamic range. The output of the mixer is amplified by Q104 (J310) a low noise, high dynamic range J-fet amplifier to insure adequate receiver sensitivity. This stage is tunable by adjusting the variable capacitor C197. The output is connected to L140 a matching transformer which passes the signal to the input of the 45 MHz crystal filter section which is composed of the following elements; C258, C162, C164, XF100, and XF101. After leaving the crystal filter section the signal passes through a capacitive matching network formed by C178, C179, and L138. The network is tuned by C178 and C179. After this the signal is divided into two parts, with part going to a J-Fet amplifier Q103 (J310) preceding the FM detector circuitry and the other part to Q102 an "AGC'd" dual gate mosfet amplifier circuit which is followed by the image reject mixer circuitry.

The FM detector is comprised of the U100 (MC3362) and its accompanying circuitry. U 100 is basically a complete narrowband FM receiver which provides recovered FM audio and an RSSI (Received Signal Strength Indicator) output both of which are sent to the 2nd IF/Audio board.

After leaving Q 102, the 45 MHz IF enters the Image Reject Mixer circuit (IRM). The IRM provides protection from the unwanted image frequency as well as providing the 50 KHz 2nd IF frequency. The IRM is composed of 4 circuit elements: the 45 MHz 90 deg. divider formed by L146, L147, L156, L157, C189, C190, C208, C188, C191 and R140; the 0 deg. divider formed by R160, R161 and R162; the 50 KHz 90 deg. divider formed by L169, L170, L171, L172, C 232, C233, C234, C241, C242 and R165; (2) double balanced mixers M1 and M2.

FRONT END BOARD PARTS LIST

REF	PART NUM	DESCRIPTION
C100	3151648	CAP AX .10 MF 50V
C101	3151259	CAP AXIAL 220 PF 10% Y5P
C102	3184019	CAP FILM .001 @ 100V 5%
C103	3184019	CAP FILM .001 @ 100V 5%
C104	3151648	CAP AX .10 MF 50V
C105	3180109	CAP ELECTRO 22@25 20%
C106	3151259	CAP AXIAL 220 PF 10% Y5P
C107	3151259	CAP AXIAL 220 PF 10% Y5P
C108	3151345	CAP AXIAL 470 PF 10% Y5P
C109	3151515	CAP AXIAL .01 MF 20% Y5P
C110	3151345	CAP AXIAL 470 PF 10% Y5P
C111	3151345	CAP AXIAL 470 PF 10% Y5P
C112	3151515	CAP AXIAL .01 MF 20% Y5P
C113	3180109	CAP ELECTRO 22@25 20%
C114	3151155	CAP AXIAL 150 PF 10% Y5P
C115	3151648	CAP AX .10 MF 50V
C116	3151648	CAP AX .10 MF 50V
C117	3151515	CAP AXIAL .01 MF 20% Y5P
C118	3151515	CAP AXIAL .01 MF 20% Y5P
C119	3151515	CAP AXIAL .01 MF 20% Y5P
C121	3151295	CAP AXIAL 330 PF 10% Y5P
C122	3151155	CAP AXIAL 150 PF 10% Y5P
C123	3151155	CAP AXIAL 150 PF 10% Y5P
C124	3151515	CAP AXIAL .01 MF 20% Y5P
C125	3180109	CAP ELECTRO 22@25 20%
C126	3151065	CAP AXIAL 100 PF 5% GP
C127	3180012	CAP ELECTRO 1@50 20%
C128	3151648	CAP AX .10 MF 50V
C129	3151648	CAP AX .10 MF 50V
C130	3151648	CAP AX .10 MF 50V
C131	3150896	CAP AXIAL 56.0 PF 5% NPO
C132	3205228	CAP VAR TRIMMER 10-120 PF
C133	3151648	CAP AX .10 MF 50V
C134	3151648	CAP AX .10 MF 50V
C135	3151515	CAP AXIAL .01 MF 20% Y5P
C136	3150595	CAP AXIAL 22.0 PF 5% NPO
C137	3151259	CAP AXIAL 220 PF 10% Y5P
C138	3151040	CAP AXIAL 82.0 PF 5% N750
C139	3151040	CAP AXIAL 82.0 PF 5% N750
C140	3151515	CAP AXIAL .01 MF 20% Y5P
C141	3180109	CAP ELECTRO 22@25 20%
C142	3150595	CAP AXIAL 22.0 PF 5% NPO
C143	3150896	CAP AXIAL 56.0 PF 5% NPO
C144	3151515	CAP AXIAL .01 MF 20% Y5P
C146	3151117	CAP AXIAL 120 PF 5% GP
C147	3150845	CAP AXIAL 47.0 PF 5% N750
C148	3150845	CAP AXIAL 47.0 PF 5% N750
C149	3151515	CAP AXIAL .01 MF 20% Y5P
C150	3180109	CAP ELECTRO 22@25 20%
C152	3151405	CAP AXIAL .001 MF 10% Y5P
C153	3151405	CAP AXIAL .001 MF 10% Y5P
C154	3180064	CAP ELECTRO 10@50 20%
C155	3151515	CAP AXIAL .01 MF 20% Y5P
C156	3151405	CAP AXIAL .001 MF 10% Y5P
C157	3151405	CAP AXIAL .001 MF 10% Y5P
C158	3151425	CAP AXIAL .0022MF 20% Y5P
C159	3150030	CAP AXIAL 1.5 PF 10% GP
C162	3166135	CAP CHIP 2.2PF 50V 0805
C164	3166136	CAP CHIP 2.2PF 50V 0805
C166	3151515	CAP AXIAL .01 MF 20% Y5P
C168	3151065	CAP AXIAL 100 PF 5% GP
C169	3150550	CAP AXIAL 20.0 PF 5% NPO
C170	3150550	CAP AXIAL 20.0 PF 5% NPO
C171	3151515	CAP AXIAL .01 MF 20% Y5P
C172	3180109	CAP ELECTRO 22@25 20%
C174	3205207	CAP VAR TRIMMER 4-20 PF
C175	3151040	CAP AXIAL 82.0 PF 5% N750
C176	3150350	CAP AXIAL 10.0 PF 5% NPO
C177	3151405	CAP AXIAL .001 MF 10% Y5P
C178	3205204	CAP VAR TRIMMER 3-11 PF
C179	3205204	CAP VAR TRIMMER 3-11 PF (3501055 SHIELD)
C180	3151515	CAP AXIAL .01 MF 20% Y5P
C181	3150550	CAP AXIAL 20.0 PF 5% NPO
C182	3151040	CAP AXIAL 82.0 PF 5% N750
C183	3150420	CAP AXIAL 12.0 PF 5% NPO
C184	3150508	CAP AXIAL 15.0 PF 5% NPO
C185	3151515	CAP AXIAL .01 MF 20% Y5P
C186	3180109	CAP ELECTRO 22@25 20%
C187	3150550	CAP AXIAL 20.0 PF 5% NPO
C188	3205228	CAP VAR TRIMMER 10-120 PF
C189	3150595	CAP AXIAL 22.0 PF 5% NPO
C190	3150595	CAP AXIAL 22.0 PF 5% NPO
C191	3205228	CAP VAR TRIMMER 10-120 PF
C192	3151155	CAP AXIAL 150 PF 10% Y5P
C193	3151155	CAP AXIAL 150 PF 10% Y5P
C194	3151405	CAP AXIAL .001 MF 10% Y5P
C195	3151405	CAP AXIAL .001 MF 10% Y5P
C196	3151405	CAP AXIAL .001 MF 10% Y5P
C197	3205207	CAP VAR TRIMMER 4-20 PF
C198	3151515	CAP AXIAL .01 MF 20% Y5P
C199	3151648	CAP AX .10 MF 50V
C200	3151515	CAP AXIAL .01 MF 20% Y5P
C202	3150779	CAP AXIAL 43.0 PF 5% NPO
C203	3150420	CAP AXIAL 12.0 PF 5% NPO
C204	3150420	CAP AXIAL 12.0 PF 5% NPO
C205	3151515	CAP AXIAL .01 MF 20% Y5P
C206	3180109	CAP ELECTRO 22@25 20%
C208	3150595	CAP AXIAL 22.0 PF 5% NPO
C209	3151117	CAP AXIAL 120 PF 5% GP
C210	3180064	CAP ELECTRO 10@50 20%
C211	3151515	CAP AXIAL .01 MF 20% Y5P
C212	3150305	CAP AXIAL 8.2 PF 10% NPO
C213	3150690	CAP AXIAL 33.0 PF 5% NPO
C214	3150305	CAP AXIAL 8.2 PF 10% NPO
C215	3150305	CAP AXIAL 8.2 PF 10% NPO
C216	3151515	CAP AXIAL .01 MF 20% Y5P
C217	3180109	CAP ELECTRO 22@25 20%
C219	3151405	CAP AXIAL .001 MF 10% Y5P
C220	3150690	CAP AXIAL 33.0 PF 5% NPO
C221	3151185	CAP AXIAL 180 PF 10% Y5P
C222	3150845	CAP AXIAL 47.0 PF 5% N750
C223	3151185	CAP AXIAL 180 PF 10% Y5P
C224	3150350	CAP AXIAL 10 PF 5% NPO

14 Front End Board Parts List cont'd.

REF	PART NUM	DESCRIPTION
C225	3151117	CAP AXIAL 120 PF 5% GP
C226	3151648	CAP AX .10 MF 50V
C227	3151648	CAP AX .10 MF 50V
C228	3151648	CAP AX .10 MF 50V
C229	3151648	CAP AX .10 MF 50V
C230	3151515	CAP AXIAL .01 MF 20% Y5P
C231	3180064	CAP ELECTRO 10@50 20%
C232	3184046	CAP FILM .033 @ 100V 5%
C233	3184046	CAP FILM .033 @ 100V 5%
C234	3184042	CAP FILM .022 @ 100V 5%
C235	3151648	CAP AX .10 MF 50V
C236	3180064	CAP ELECTRO 10@50 20%
C237	3151515	CAP AXIAL .01 MF 20% Y5P
C238	3151515	CAP AXIAL .01 MF 20% Y5P
C239	3180232	CAP ELECTRO 330@25 RADIAL
C240	3151648	CAP AX .10 MF 50V
C241	3184042	CAP FILM .022 @ 100V 5%
C242	3184042	CAP FILM .022 @ 100V 5%
C243	3151648	CAP AX .10 MF 50V
C244	3151648	CAP AX .10 MF 50V
C245	3151648	CAP AX .10 MF 50V
C246	3151459	CAP AX .0047MF +80-20 Z5U
C247	3151648	CAP AX .10 MF 50V
C248	3151648	CAP AX .10 MF 50V
C249	3151648	CAP AX .10 MF 50V
C250	3151648	CAP AX .10 MF 50V
C251	3180012	CAP ELECTRO 1@50 20%
C252	3151648	CAP AX .10 MF 50V
C253	3151648	CAP AX .10 MF 50V
C254	3151648	CAP AX .10 MF 50V
C255	3151648	CAP AX .10 MF 50V
C256	3151648	CAP AX .10 MF 50V
C257	3151648	CAP AX .10 MF 50V
C258	3167507	CAP CHIP 12pF NPO 0805
CF100	3140403	FILTER CER. SFE 10.7MJZ
CF101	3140405	FILTER CERAMIC CFU455E-2
CR100	3020335	DIODE 1S2186
CR101	3020335	DIODE 1S2186
CR102	3020335	DIODE 1S2186
CR103	3020335	DIODE 1S2186
CR104	3020335	DIODE 1S2186
CR105	3020335	DIODE 1S2186
CR106	3020335	DIODE 1S2186
CR107	3020335	DIODE 1S2186
CR108	3020335	DIODE 1S2186
CR109	3020335	DIODE 1S2186
CR110	3020335	DIODE 1S2186
CR111	3020335	DIODE 1S2186
CR112	3020335	DIODE 1S2186
CR113	3020335	DIODE 1S2186
CR114	3020335	DIODE 1S2186
CR115	3020335	DIODE 1S2186
CR116	3020335	DIODE 1S2186
CR117	3020335	DIODE 1S2186
CR118	3020335	DIODE 1S2186
CR119	3020335	DIODE 1S2186
CR120	3020335	DIODE 1S2186
CR121	3020335	DIODE 1S2186
CR123	3020335	DIODE 1S2186
CR124	3020335	DIODE 1S2186

REF	PART NUM	DESCRIPTION
CR125	3020335	DIODE 1S2186
CR126	3020335	DIODE 1S2186
CR127	3020220	DIODE 1N4005-PLASTIC
CR128	3020220	DIODE 1N4005-PLASTIC
CR129	3020220	DIODE 1N4005-PLASTIC
CR130	3020220	DIODE 1N4005-PLASTIC
FL101	3140411	FILT. CER. RMC-2A6597HM
J100	3280042	CONN.COAX PC MT. 90 DEG.
J101	3280042	CONN.COAX PC MT. 90 DEG.
J102	3280042	CONN.COAX PC MT. 90 DEG.
J103	3280042	CONN.COAX PC MT. 90 DEG.
J104	3280042	CONN.COAX PC MT. 90 DEG.
J105	3301253	TERM.STP 3-CKT
L100	3524199	COIL RADIAL 1.0 MH
L101	3524193	COIL RADIAL 150.0 UH
L102	3524196	COIL RADIAL 270.0 UH
L103	3524193	COIL RADIAL 150.0 UH
L104	3524199	COIL RADIAL 1.0 MH
L105	3524196	COIL RADIAL 270.0 UH
L106	3524186	COIL RADIAL 68.0 UH
L107	3524188	COIL RADIAL 82.0 UH
L108	3524186	COIL RADIAL 68.0 UH
L109	3524196	COIL RADIAL 270.0 UH
L110	3524205	COIL AXIAL 1.1 UH
L111	3524515	COIL VAR. SHLD
L112	3524188	COIL RADIAL 82.0 UH
L113	3524185	COIL RADIAL 56.0 UH
L114	3524176	COIL RADIAL 22.0 UH
L115	3524185	COIL RADIAL 56.0 UH
L116	3524188	COIL RADIAL 82.0 UH
L117	3524185	COIL RADIAL 56.0 UH
L118	3524178	COIL RADIAL 33.0 UH
L119	3524173	COIL RADIAL 15.0 UH
L120	3524178	COIL RADIAL 33.0 UH
L121	3524185	COIL RADIAL 56.0 UH
L122	3524177	COIL RADIAL 27.0 UH
L123	3524172	COIL RADIAL 18.0 UH
L124	3524170	COIL RADIAL 8.2 UH
L125	3524172	COIL RADIAL 18.0 UH
L126	3524177	COIL RADIAL 27.0 UH
L127	3524165	COIL RADIAL 5.6 UH
L128	2510082	INDUCTOR TOROID
L129	3524165	COIL RADIAL 5.6 UH
L133	3524171	COIL RADIAL 10.0 UH
L134	3524173	COIL RADIAL 15.0 UH
L135	3524160	COIL RADIAL 3.3 UH
L136	3524173	COIL RADIAL 15.0 UH
L137	3524171	COIL RADIAL 10.0 UH
L138	2510103	INDUCTOR TOROID
L139	3524164	COIL RADIAL 4.7 UH
L140	2510104	INDUCTOR TOROID (3501056 SHIELD)
L141	3524168	COIL RADIAL 6.8 UH
L142	3524171	COIL RADIAL 10.0 UH
L143	3524155	COIL RADIAL 2.2 UH
L144	3524171	COIL RADIAL 10.0 UH
L145	3524168	COIL RADIAL 6.8 UH
L146	2510083	INDUCTOR TOROID
L147	2510083	INDUCTOR TOROID

REF	PART NUM	DESCRIPTION
L148	3524136	COIL AXIAL 0.1 UH
L149	3524136	COIL AXIAL 0.1 UH
L150	3524165	COIL RADIAL 5.6 UH
L151	3524165	COIL RADIAL 5.6 UH
L152	3524165	COIL RADIAL 5.6 UH
L153	3524152	COIL RADIAL 1.8 UH
L154	3524165	COIL RADIAL 5.6 UH
L155	3524165	COIL RADIAL 5.6 UH
L156	2510083	INDUCTOR TOROID
L157	2510083	INDUCTOR TOROID
L158	2510079	INDUCTOR TOROID
L159	3524155	COIL RADIAL 2.2 UH
L160	3524160	COIL RADIAL 3.3 UH
L161	3524148	COIL RADIAL 1.0 UH
L162	3524160	COIL RADIAL 3.3 UH
L163	3524155	COIL RADIAL 2.2 UH
L164	3524138	COIL RADIAL 0.27 UH
L165	3524138	COIL RADIAL 0.27 UH
L166	3524140	COIL RADIAL 0.33 UH
L167	3524196	COIL RADIAL 270.0 UH
L168	2510079	INDUCTOR TOROID
L169	3520534	CHOKE ASSY 160.0 UH
L170	3520534	CHOKE ASSY 160.0 UH
L171	3520534	CHOKE ASSY 160.0 UH
L172	3520534	CHOKE ASSY 160.0 UH
L173	2510078	INDUCTOR TOROID
L174	3524196	COIL RADIAL 270.0 UH
L175	3524199	COIL RADIAL 1.0 MH
L176	2510079	INDUCTOR TOROID
M1	3045002	I.C. BAL. MIXER SBL1-X
M2	3045002	I.C. BAL. MIXER SBL1-X
M3	3045004	I.C. BAL. MIXER SBL-3
P100	3280723	CONN P.C. 3 PIN MALE
P101	3280724	CONN P.C. 4 PIN MALE
P102	3280723	CONN P.C. 3 PIN MALE
P103	3280723	CONN P.C. 3 PIN MALE
P104	3280723	CONN P.C. 3 PIN MALE
P105	3280723	CONN P.C. 3 PIN MALE
P106	3280720	CONN P.C. 8 PIN MALE
P107	3280720	CONN P.C. 8 PIN MALE
Q100	3030104	TRANSISTOR 2N3904
Q102	3030286	TRANSISTOR 3SK81
Q103	3030504	TRANSISTOR J-310
Q104	3030504	TRANSISTOR J-310
Q105	3030137	TRANSISTOR 2N5109 (3493040 HEAT SINK)
Q106	3030104	TRANSISTOR 2N3904
Q107	3030104	TRANSISTOR 2N3904
Q108	3030104	TRANSISTOR 2N3904
Q109	3030104	TRANSISTOR 2N3904
R100	3220055	RES C.FILM 100 OHM 5%1/4W
R101	3220055	RES C.FILM 100 OHM 5%1/4W
R102	3220210	RES C.FILM 4.7 K 5% 1/4W
R103	3220275	RES C.FILM 33 K 5% 1/4W
R104	3220110	RES C.FILM 470 OHM 5%1/4W
R105	3220275	RES C.FILM 33 K 5% 1/4W
R106	3220055	RES C.FILM 100 OHM 5%1/4W
R107	3220055	RES C.FILM 100 OHM 5%1/4W
R108	3220085	RES C.FILM 270 OHM 5%1/4W
R109	3220090	RES C.FILM 330 OHM 5%1/4W
R110	3220085	RES C.FILM 270 OHM 5%1/4W
R111	3220210	RES C.FILM 4.7 K 5% 1/4W
R112	3220235	RES C.FILM 10 K 5% 1/4W
R113	3220315	RES C.FILM 100 K 5% 1/4W
R114	3220090	RES C.FILM 330 OHM 5%1/4W
R115	3220060	RES C.FILM 120 OHM 5%1/4W
R116	3220200	RES C.FILM 3.3 K 5% 1/4W
R117	3260612	RES VAR PT10V LIN 500K
R118	3220055	RES C.FILM 100 OHM 5%1/4W
R119	3220055	RES C.FILM 100 OHM 5%1/4W
R120	3220210	RES C.FILM 4.7 K 5% 1/4W
R121	3220300	RES C.FILM 68 K 5% 1/4W
R122	3220347	RES C.FILM 510 K 5% 1/4W
R123	3220330	RES C.FILM 220 K 5% 1/4W
R124	3220055	RES C.FILM 100 OHM 5%1/4W
R125	3220055	RES C.FILM 100 OHM 5%1/4W
R126	3220210	RES C.FILM 4.7 K 5% 1/4W
R127	3220055	RES C.FILM 100 OHM 5%1/4W
R128	3220055	RES C.FILM 100 OHM 5%1/4W
R129	3220210	RES C.FILM 4.7 K 5% 1/4W
R130	3220055	RES C.FILM 100 OHM 5%1/4W
R131	3220045	RES C.FILM 68 OHM 5%1/4W
R132	3220055	RES C.FILM 100 OHM 5%1/4W
R133	3220015	RES C.FILM 22 OHM 5%1/4W
R135	3220355	RES C.FILM 1M 5% 1/4W
R136	3220085	RES C.FILM 270 OHM 5%1/4W
R137	3220055	RES C.FILM 100 OHM 5%1/4W
R138	3220055	RES C.FILM 100 OHM 5%1/4W
R139	3220210	RES C.FILM 4.7 K 5% 1/4W
R140	3220035	RES C.FILM 47 OHM 5%1/4W
R141	3220060	RES C.FILM 120 OHM 5%1/4W
R142	3220055	RES C.FILM 100 OHM 5%1/4W
R143	3220235	RES C.FILM 10 K 5% 1/4W
R144	3220055	RES C.FILM 100 OHM 5%1/4W
R145	3220055	RES C.FILM 100 OHM 5%1/4W
R146	3220210	RES C.FILM 4.7 K 5% 1/4W
R147	3220035	RES C.FILM 47 OHM 5%1/4W
R148	3220035	RES C.FILM 47 OHM 5%1/4W
R149	3220005	RES C.FILM 10 OHM 5%1/4W
R150	3220090	RES C.FILM 330 OHM 5%1/4W
R151	3220055	RES C.FILM 100 OHM 5%1/4W
R152	3220055	RES C.FILM 100 OHM 5%1/4W
R153	3220210	RES C.FILM 4.7 K 5% 1/4W
R154	3220345	RES C.FILM 470 K 5% 1/4W
R156	3220070	RES C.FILM 180 OHM 5%1/4W

16 Front End Board Parts List cont'd.

REF	PART NUM	DESCRIPTION
R157	3220055	RES C.FILM 100 OHM 5%1/4W
R158	3220055	RES C.FILM 100 OHM 5%1/4W
R159	3220210	RES C.FILM 4.7 K 5% 1/4W
R160	3220010	RES C.FILM 15 OHM 5%1/4W
R161	3220010	RES C.FILM 15 OHM 5%1/4W
R162	3220010	RES C.FILM 15 OHM 5%1/4W
R163	3220055	RES C.FILM 100 OHM 5%1/4W
R164	3220090	RES C.FILM 330 OHM 5%1/4W
R165	3220035	RES C.FILM 47 OHM 5%1/4W
R166	3220210	RES C.FILM 4.7 K 5% 1/4W
R167	3220160	RES C.FILM 1.0 K 5% 1/4W
R168	3220235	RES C.FILM 10 K 5% 1/4W
R169	3220315	RES C.FILM 100 K 5% 1/4W
R170	3220235	RES C.FILM 10 K 5% 1/4W
R171	3220315	RES C.FILM 100 K 5% 1/4W
R172	3220047	RES C.FILM 75 OHM 5%1/4W
R173	3220085	RES C.FILM 270 OHM 5%1/4W
R174	3220015	RES C.FILM 22 OHM 5%1/4W
R175	3220315	RES C.FILM 100 K 5% 1/4W
R176	3220235	RES C.FILM 10 K 5% 1/4W
R177	3220315	RES C.FILM 100 K 5% 1/4W
R178	3220235	RES C.FILM 10 K 5% 1/4W
R179	3220315	RES C.FILM 100 K 5% 1/4W
R180	3220315	RES C.FILM 100 K 5% 1/4W
R181	3220315	RES C.FILM 100 K 5% 1/4W
R182	3220315	RES C.FILM 100 K 5% 1/4W
R183	3220200	RES C.FILM 3.3 K 5% 1/4W
R184	3220215	RES C. FILM 5.6K, 5%, 1/4W
RL100	3620112	RELAY TAKAMISAWA #RZ-12K
RL101	3620108	RELAY ITT #MZ12HG
RL102	3620108	RELAY ITT #MZ12HG
RL103	3620108	RELAY ITT #MZ12HG
U100	3040595	I.C. MC3362
U101	3040094	I.C. LM358
U102	3040509	I.C. 74LS145N
VR100	3040031	I.C. 78LO5-ACP
VR101	3040092	I.C. LM317LZ
XF100	3140126	CRYSTAL FILTER #45U12B
XF101		(MATCHED SET OF TWO)
Y100	3120289	CRYSTAL 34.3 MHZ
Y101	3120136	CRYSTAL 10.245 MHZ

Front End Board Schematic D-8211

Note: This drawing applies to R8/R8E units with serial (S/N) numbers **previous to 11100000** (November 1991)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

A B C D E F G H I J K L M N O P Q R S

REAR PANEL ANT 2 50Ω J105 3301263 — L176 2510079 — R163 100 — RL102 — C228 .1uF — L158 2510079 — R164 330 — C230 .01uF — C231 10uF

ANT 1 50Ω J104 — RL101 — RL103 — VHF CONV 50Ω J101 — R172 75 — C229 .1uF

+11-16VDC FIL — CR129 1N4005 — CR127 1N4005 — CR130 1N4005 — Q108 2N3904 — Q107 2N3904 — Q109 2N3904

ANT1: 0VDC ANT2: 2.7VDC — ANT1/ANT2 — R176 10K — R175 100K

HF: 0VDC VHF: 2.7VDC — HF/VHF — R170 10K — R171 100K

ATTN ON: 2.7VDC OFF: 0VDC — ATTN ENA — R178 10K — R177 100K

BANDPASS FILTERS

182186 X 24 — CR126 CR125 — C215 8.2pF — L162 3.3uH — C214 8.2pF — L160 3.3uH — CR124 CR123 — C212 8.2pF — L163 2.2uH — L161 1uH — L159 2.2uH — C213 33pF — C216 .01uF — R168 100 — R157 100 — C211 .01uF

BAND 9 — 22-30MHZ — C217 22uF — R159 4.7K

CR121 CR120 — C204 12pF — L154 5.6uH — C203 12pF — L152 5.6uH — CR119 CR118 — L155 5.6uH — L153 1.8uH — L151 5.6uH — C202 43pF — C205 .01uF — R152 100 — R151 100 — C200 .01uF

BAND 8 — 15-22MHZ — C206 22uF — R153 4.7K

CR115 — C184 15pF — L144 10uH — C183 12pF — L142 10uH — CR114 CR113 — L145 5.6uH — L143 2.2uH — L141 5.6uH — C187 20pF — C182 82pF — C181 20pF — CR117 182186 — C185 .01uF — R145 100 — R144 100 — C180 .01uF

BAND 7 — 10.6-15MHZ — C166 22uF — R146 4.7K

CR111 — C170 20pF — L138 15uH — C169 20pF — L134 15uH — CR110 — L137 10uH — L135 3.3uH — L133 10uH — C188 100pF — C171 .01uF — R138 100 — R137 100 — C165 .01uF

BAND 6 — 7.5-10.5MHZ — C172 22uF — R139 4.7K

CR109 — C148 47pF — L125 18uH — C147 47pF — L123 18uH — CR108 — L128 27uH — L124 8.2uH — L122 27uH — C146 120pF — C149 .01uF — R128 100 — R127 100 — C144 .01uF

BAND 5 — 4.0-7.5MHZ — C150 22uF — R128 4.7K

CR107 — C139 82pF — L120 33uH — C138 82pF — L118 33uH — CR106 — L121 56uH — L119 15uH — L117 56uH — C142 22pF — C137 220pF — C136 22pF — C140 .01uF — R125 100 — R124 100 — C135 .01uF

BAND 4 — 2.5-4.0MHZ — C141 22uF — R120 4.7K

CR105 — C123 100pF — L115 56uH — C122 150pF — L113 56uH — CR104 — L116 82uH — C126 100pF — L114 22uH — C121 330pF — L112 82uH — C124 .01uF — R119 100 — R118 100 — C119 .01uF

BAND 3 — 1.5-2.5MHZ — C125 22uF — R182 100K

CR103 — P101 — R110 270 — R108 270 — C111 470pF — L108 68uH — L106 68uH — C106 470pF — CR102 — C114 150pF — R109 330 — L109 270uH — L107 82uH — C110 470pF — L105 270uH — C107 220pF — C112 .01uF — R107 100 — R106 100 — C108 .01uF

BAND 2 — 0.5-1.5MHZ — C113 22uF — R111 4.7K — R181 100K

CR101 — L103 150uH — L102 270uH — L101 150uH — CR100 — L104 1mH — C105 220pF — C103 1000pF FILM — C102 1000pF FILM — L100 1mH — C101 220pF — C104 .1uF — R101 100 — R100 100 — C100 .1uF

BAND 1 — 0.1-0.5MHZ — C105 22uF — R102 4.7K — R179 100K

U102 74LS145 — pins 12 13 14 15

NODE VOLTAGES: BAND SELECTED

NODE	YES	NO
A	2.2VDC	9.7VDC
B	2.2VDC	9.7VDC
C	2.2VDC	9.7VDC
D	2.2VDC	9.7VDC
E	2.2VDC	9.7VDC
F	2.2VDC	9.7VDC
G	2.2VDC	9.7VDC
H	2.2VDC	9.7VDC
J	2.2VDC	9.7VDC
K	2.2VDC	9.7VDC
L	2.2VDC	9.7VDC
M	2.2VDC	9.7VDC
N	2.2VDC	9.7VDC
P	2.2VDC	9.7VDC
R	2.2VDC	9.7VDC

U102, PINS 1-7, 9, 10, 16: 9.6VDC WHEN SELECTED, 0.4VDC WHEN NOT SELECTED

U102, PINS 12-15: 4.6VDC OR 0VDC (DEPENDENT ON BAND)

PRE AMP

L158 2510079 — C227 .1uF — RL100 — RL100 3620112 — C199 .1uF — R150 330 — +10V — C198 .01uF — C237 .01uF — C235 10uF — L174 270uH — L173 2510078 — C238 .01uF — R166 4.7K — Q105 2N5109 — HEAT SINK — R167 1K — R174 22 — R173 390 — C245 4700pF

PREAMP ON: 1.6VDC OFF: 0.0V — PREAMP ON: 1.6VDC OFF: 0.0V — PREAMP ON: 1.0VDC OFF: 0.0V

C228 .1uF — P105 — L167 270uH — +11-16VDC FIL — L175 16H — +11-16VDC IN — C247 .1uF — C239 330uF 50V — CR128 1N4005 — PREAMP ON: .2VDC ATTN ON: 13.6VDC PREAMP/ATTN OFF: 12.9VDC — Q106 2N3904 — PREAMP ON: 0.6VDC OFF: 0VDC — R168 10K — R169 100K

C224 10pF — C222 47pF — C220 33pF — L166 .33uH — L165 .27uH — L164 .27uH — C225 120pF — C223 160pF — C221 160pF — C209 120pF

45 MHZ IF SECTION

H3 SBL-3 — 2, 5, 6, 7 — 3, 4 — 1ST LO IN 45-76 MHz 1.12Vpp 0VDC — J100 — R156 100

L148 .1uH — C193 150pF — P104 — R147 47 — R148 47 — C192 150pF — 1.5VDC — C194 1000pF — R142 100 — L139 4.7uH — Q104 J310 — 9.7VDC — R143 6.8K — L140 2510022 — C165 9pF CHIP — L132 3624119 — C164 3.9pF CHIP — XF101 — XF100 — 3140126 — L131 3624119 — C162 3.9pF CHIP — C163 9pF CHIP — P102 — C178 3-11pF — C179 3-11pF — L138 2510082

C197 4-20pF — C196 1000pF — R148 10 — C195 1000pF — C210 10uF — L150 5.6uH — +10V

0VDC — Q103 J310 — 9.1VDC — R135 100K — C160 4-20pF — L130 2510082 — C159 1.8pF — R136 270 — C161 1000pF — L129 5.6uH — +10V — C157 1000pF — R132 100 — C156 1000pF — C154 10uF — C155 .01uF

9.3VDC — Q102 3N204 — R131 68 — R133 22 — R134 4.7K — C174 4-20pF — C176 10pF — C175 82pF — P103 — L128 2510082 (SEE NOT 1) 0.4VDC — R141 120 — C177 1000pF — R130 100 — L127 5.6uH — C152 1000pF — C153 1000pF — R154 470K — R155 4.7K — CR122 1N4148 — 3.6VDC — C158 .0022uF

IMAGE REJECT MIXER SECTION

C188 4-120pF — L146 2510083 — L156 2510083 — C190 22pF — C208 22pF — L147 2510083 — L157 2510083 — C189 22pF — C191 10-120pF — R140 47 — H1 SBL-1X — H2 SBL-1X — 2, 5, 6, 7 — 3, 4 — R161 15 — R160 15

L170 160uH — C242 .022uF FILM — L171 150uH — C235 .1uF — J103 — IF OUT 50 KHz — C232 .033uF FILM — C233 .033uF FILM — C234 .022uF FILM — L169 160uH — L172 150uH — C241 .022uF FILM — R165 47 — R162 15 — C219 1000pF — J102 — 2ND LO IN 45.05 MHz 2VPP 0VDC

FM DETECTOR

+10V — VR101 LM317J — FM: ON 4.6VDC OFF 1.3VDC — C127 1uF — R115 120 — C115 .1uF — R114 330 — FM: ON 3.4VDC OFF 0.1VDC — FM: ON 0.2VDC OFF 0.7VDC — R112 10K — Q100 2N3904 — R113 100K — FM: ON 8VDC OFF 0.2VDC

C143 56pF — C132 10-120pF — C131 56pF — Y101 10.245MHz — CF101 3140405 — C130 .1uF — C129 .1uF — R121 66K — C128 .1uF — FL101 3140411

U100 HC3362 — R183 3.3K — R116 3.3K — R105 33K — R103 33K — R104 470 — Y100 34.3MHz — C117 .01uF — C118 .01uF — L111 F 3524515 — L110 1.1uH — CF100 3140403 — C116 .1uF

FM ON 10.245MHz 0.28Vpp 4.1VDC — FM OFF 0VAC 0VDC — FM ON 34.3MHz 0.84Vpp 3.4VDC — FM OFF 0VAC 0VDC

+10V — R117 500K — R123 220K — C133 .1uF — U101A LM358 — FM ON 5.3VDC OFF 2.0VDC — R122 510K — U101B LM358 — C134 .1uF — FM ON 0.25VDC 0.01Vpp — OFF 0.15VDC — FM ON 0.25VDC 0.01Vpp — OFF 0.8VDC — FM ON 1.9VDC OFF 0.4VDC

ATTN ON: 2.7VDC OFF: 0VDC — PREAMP ON: 2.8VDC OFF: 0VDC — P107 — ATTN. ENABLE — H F/ VHF — ANT1 / ANT2 — PREAMP ENABLE — ATTN ENA — HF/VHF — ANT1/ANT2 — D3 D2 D1 D0 — ANT1: 0VDC ANT2: 2.7VDC — HF: 0VDC VHF: 2.7VDC

P106 — GND — FM ENABLE — +10V&W — +11-16VDC IN — AGC — GND — RSSI OUT — FM AUDIO OUT — +10V&W — +11-16V IN

C257 .1uF — C256 .1uF — C255 .1uF — C254 .1uF — C253 .1uF — C250 .1uF — C249 .1uF — C248 .1uF — C240 .1uF — C245 .1uF — C244 .1uF — C243 .1uF

HIGHEST DESIGNATORS	
CAPS	C257
DIODES	CR130
INDUCTORS	L178
RESISTORS	R183
TRANSISTORS	Q110

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Front End Board Schematic D-8211

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Note: This drawing applies to R8/R8E units with serial (S/N) numbers **after 11100001** (November 1991)

NOTES:
1) NODE VOLTAGES MEASURED WITH RF GAIN TURNED FULL CW, AND NO INPUT SIGNAL.

REAR PANEL J105
ANT 2 50Ω
50 3301253
G/R
Y/G
L176 2510079
RL103
RL101
RL102
R163 100
C228 .1uF
L168 2510079
ANT 1 50 J104
VHF CONV 50 J101
R172 75
C229 .1uF
R164 330
C231 10uF
C230 .01uF
+10V
+11-16VDC FIL
CR129 1N4005
CR127 1N4005
CR130 1N4005
ANT1: 0VDC
ANT2: 2.7VDC
R176 0 OHM
Q108 2N3904
ANT1/ANT2
R175 100K
R170 0 OHM
Q107 2N3904
R171 100K
HF: 0VDC
VHF: 2.7VDC
HF/VHF
ATTN ON: 2.7VDC
OFF: 0VDC
ATTN ENA
R178 0 OHM
Q109 2N3904
R177 100K

BANDPASS FILTERS

1S2185 X 24
CR126 CR125
C215 8.2pF
L162 3.3uH
C214 8.2pF
L160 3.3uH
CR124 CR123
L163 2.2uH
L161 1uH
C213 33pF
L159 2.2uH
C212 8.2pF
C216 .01uF
R158 100
R157 100
C211 .01uF
BAND 9
22-30MHZ
C217 22uF
CR121 CR120
C204 12pF
L154 5.6uH
C203 12pF
L152 5.6uH
CR119 CR118
L155 5.6uH
L153 1.8uH
C202 43pF
L151 5.6uH
C205 .01uF
R152 100
R151 100
C200 .01uF
BAND 8
15-22MHZ
C206 22uF
CR116 CR115
C184 15pF
L144 10uH
C183 12pF
L142 10uH
CR114 CR113
L145 6.8uH
L143 2.2uH
C182 62pF
L141 6.8uH
C181 20pF
CR117 1S2186
C185 .01uF
R145 100
R144 100
C180 .01uF
CR112
BAND 7
10.5-15MHZ
C186 22uF
CR111 CR110
C170 20pF
L136 15uH
C169 20pF
L134 15uH
L137 10uH
L135 3.3uH
C168 100pF
L133 10uH
C173 .01uF
R138 100
R137 100
C166 .01uF
BAND 6
7.5-10.5MHZ
C172 22uF
CR109 CR108
C148 47pF
L125 18uH
C147 47pF
L123 18uH
L126 27uH
L124 8.2uH
C146 120pF
L122 27uH
C149 .01uF
R128 100
R127 100
C144 .01uF
BAND 5
4.0-7.5MHZ
C150 22uF
CR107 CR106
C139 82pF
L120 33uH
C138 82pF
L118 33uH
L121 56uH
L119 15uH
C137 220pF
L117 56uH
C136 22pF
C140 .01uF
C142 22pF
R125 100
R124 100
C135 .01uF
BAND 4
2.5-4.0MHZ
C141 22uF
CR105 CR104
C123 150pF
L115 56uH
C122 150pF
L113 56uH
L116 82uH
C126 100pF
L114 22uH
C121 330pF
L112 82uH
C124 .01uF
R119 100
R118 100
C119 .01uF
BAND 3
1.5-2.5MHZ
C125 22uF
P101
P100
CR103 CR102
R110 270
C111 470pF
L108 68uH
L106 68uH
C108 470pF
C114 150pF
L109 270uH
L107 82uH
C110 470pF
L105 270uH
C107 220pF
C112 .01uF
R109 330
R107 100
R106 100
C109 .01uF
BAND 2
0.5-1.5MHZ
C113 22uF
CR101 CR100
L104 1mH
C106 220pF
L103 150uH
L102 270uH
L101 150uH
C103 1000pF FILM
C102 1000pF FILM
L100 16M
C101 220pF
C104 1uF
R101 100
R100 100
C100 .1uF
BAND 1
0.1-0.5MHZ
C105 22uF
+10V
R159 4.7K
R153 4.7K
R146 4.7K
R139 4.7K
R129 4.7K
R126 4.7K
R120 4.7K
R111 4.7K
R102 4.7K

NODE VOLTAGES:

NODE	BAND SELECTED YES	NO
A	2.4VDC	9.7VDC
B	2.4VDC	9.7VDC
C	2.4VDC	9.7VDC
D	2.4VDC	9.7VDC
E	2.2VDC	9.7VDC
F	2.2VDC	9.7VDC
G	2.3VDC	9.7VDC
H	2.3VDC	9.7VDC
I	2.3VDC	9.7VDC
J	2.3VDC	9.7VDC
K	2.3VDC	9.7VDC
L	2.3VDC	9.7VDC
M	2.3VDC	9.7VDC
N	2.3VDC	9.7VDC
O	2.3VDC	9.7VDC
P	2.3VDC	9.7VDC
Q	2.3VDC	9.7VDC
R	2.3VDC	9.7VDC

U102, PINS 1-7, 9, 10, 16: 9.6VDC WHEN SELECTED 0.4VDC WHEN NOT SELECTED
U102, PINS 12-15: 4.9VDC OR 0VDC (DEPENDENT ON BAND)

U102 74LS145
VR100 78L05
C252 .1uF
C251 1uF

L158 2510079
C227 .1uF
RL100
RL100 3620112
R150 330
+10V
C199 .1uF
C198 .01uF

PRE AMP

C237 .01uF
C236 10uF
L174 270uH
L173 2510079
C238 .01uF
R168 4.7K
Q105 2N5109
HEAT SINK
PREAMP ON: 1.8VDC OFF: 0.0V
R167 1K
R174 22
PREAMP ON: 1.0VDC OFF: 0.0V
R173 330
C246 4700pF
PREAMP ON: 1.6VDC OFF: 0.0V
C226 .1uF
P105
L167 270uH
+11-16VDC FIL
L175 1mH
+11-16VDC IN
C247 .1uF
C239 330uF 50V
CR128 1N4005
PREAMP ON: .2VDC ATTN ON: 13.6VDC PREAMP/ATTN OFF: 12.9VDC
PREAMP ON: 0.6VDC OFF: 0VDC
Q106 2N3904
R166 10K
R169 100K
C224 10pF
C222 47pF
C220 33pF
C225 120pF
L166 .33uH
L165 .67uH
L164 .27uH
C223 180pF
C221 180pF
C209 120pF

45 MHZ IF SECTION

M3 SBL-3
1ST LO IN 45-75 MHz 1.15Vpp 0VDC
J100
2, 5, 6, 7
3, 4
R156 160
L149 .1uH
C193 150pF
P104
C194 1000pF
1.5VDC
Q104 J310
9.7VDC
R147 47
R148 47
L148 .1uH
C192 150pF
R142 100
L139 4.7uH
C197 4-20pF
C195 1000pF
R143 6.8K
L140 2510022
C185 9pF CHIP
L132 3524119
XF101
XF100
L131 3524119
C163 9pF CHIP
P102
C164 3.9pF CHIP
3140126
C162 3.9pF CHIP
C179 3-11pF
C178 3-11pF
L138 2510082
L150 5.6uH
C196 1000pF
C210 10uF
+10V
0VDC
R135 100K
Q103 J310
9.1VDC
2.0VDC
C160 4-20pF
C161 1000pF
L130 2510082
C159 1.5pF
R136 270
L129 5.6uH
R132 100
C157 1000pF
C156 1000pF
C154 10uF
C155 .01uF
9.3VDC
R131 66
Q102 3N204
(SEE NOT 1)
9.4VDC
R133 22
R134 4.7K
C158 .0022uF
R141 120
C177 1000pF
C174 4-20pF
C176 10pF
C175 82pF
L128 2510082
R130 100
L127 5.6uH
C153 1000pF
R154 470K
R155 4.7H
CR122 1N4148
3.5VDC
P103

IMAGE REJECT MIXER SECTION

C188 (10-120pF)
L146 2510083
L155 2510083
C189 22pF
C190 22pF
C208 22pF
L147 2510083
L157 2510083
R140 47
C191 10-120pF
H1 SBL-1X
H2 SBL-1X
2, 5, 6, 7
3, 4
R161 15
R160 15
C242 .022uF FILM
L170 160uH
L171 160uH
C235 .1uF
J103
IF OUT 50 KHz
C232 .033uF FILM
C233 .033uF FILM
C234 .022uF FILM
L169 160uH
L172 160uH
R165 47
C241 .022uF FILM
R162 15
C219 1000pF
J102
2ND LO IN 45.05 MHz 2Vpp 0VDC

FM DETECTOR

+10V
VR101 LM317-L
C127 1uF
R114 330
R115 120
FM: ON 4.6VDC OFF 1.3VDC
C115 .1uF
C143 56pF
C117 .01uF
R105 22K
R103 22K
R104 470
C132 10-120pF
C131 56pF
Y101 10.245MHz
CF101 3140405
U100 MC3362
L111 3524119
Y100 34.3MHz
L110 .68uH
CF100 3140403
C118 .1uF
FM: ON 3.4VDC OFF 0.1VDC
FM: ON 0.2VDC OFF 0.7VDC
R112 10K
Q100 2N3904
R113 100K
FM: ON 8VDC OFF 0.2VDC
C130 .1uF
C129 .1uF
R121 68K
C128 .1uF
FL101 3140411
R183 3.3K
R116 3.3K
R117 500K
R123 220K
C133 .1uF
U101A LM358
FM ON 5.3VDC OFF 2.0VDC
R122 510K
U101B LM358
C134 .1uF
FM ON 0.25VDC 0.01Vpp
OFF 0.15VDC
FM ON 0.25VDC 0.01Vpp
OFF 0.6VDC
FM ON 10.245MHz 0.28Vpp 4.1VDC
FM OFF 0VAC 0VDC
FM ON 34.3MHz 0.84Vpp 3.4VDC
FM OFF 0VAC 0VDC
FM ON 1.9VDC OFF 0.4VDC

ATTN ON: 2.7VDC OFF: 0VDC
PREAMP ON: 2.6VDC OFF: 0VDC
P107
ATTN. ENABLE
H F/ VHF
ANT1 / ANT2
PREAMP ENABLE
ATTN ENA
HF/VHF
(ANT1/ANT2)
ANT1: 0VDC ANT2: 2.7VDC
HF: 0VDC VHF: 2.7VDC
D3
D2
D1
D0
P106
GND
FH ENABLE
+10VSW
+11-16VDC IN
AGC
GND
RSSI OUT
FH AUDIO OUT
+10VSW
+11-16V IN
R182 100K
R181 100K
R180 100K
R179 100K
C257 .1uF
C256 .1uF
C255 .1uF
C254 .1uF
C253 .1uF
C250 .1uF
C249 .1uF
C248 .1uF
C240 .1uF
C245 .1uF
C244 .1uF
C243 .1uF

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Front End Board Schematic 17
D-8211

Note: This drawing applies to R8/R8E units with revisions "D" and "E" printed circuit board artwork.

BANDPASS FILTERS

PRE AMP

45 MHZ IF SECTION

IMAGE REJECT MIXER SECTION

FM DETECTOR

NODE VOLTAGES:	BAND SELECTED	
NODE	YES	NO
A	2.2VDC	9.7VDC
B	2.2VDC	9.7VDC
C	2.2VDC	9.7VDC
D	2.2VDC	9.7VDC
E	2.2VDC	9.7VDC
F	2.2VDC	9.7VDC
G	2.3VDC	9.7VDC
H	2.3VDC	9.7VDC
I	2.3VDC	9.7VDC
J	2.3VDC	9.7VDC
K	2.3VDC	9.7VDC
L	2.3VDC	9.7VDC
M	2.3VDC	9.7VDC
N	2.3VDC	9.7VDC
O	2.3VDC	9.7VDC
P	2.3VDC	9.7VDC
Q	2.3VDC	9.7VDC
R	2.3VDC	9.7VDC

U102, PINS 1-7, 9, 10, 16:
9.6VDC WHEN SELECTED
0.4VDC WHEN NOT SELECTED

U102, PINS 12-15:
4.9VDC OR 0VDC
(DEPENDENT ON BAND)

HIGHEST DESIGNATORS	
CAPS	C258
DIODES	CR130
INDUCTORS	L176
RESISTORS	R184
TRANSISTORS	Q109

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Front End Board Pictorial D-8135

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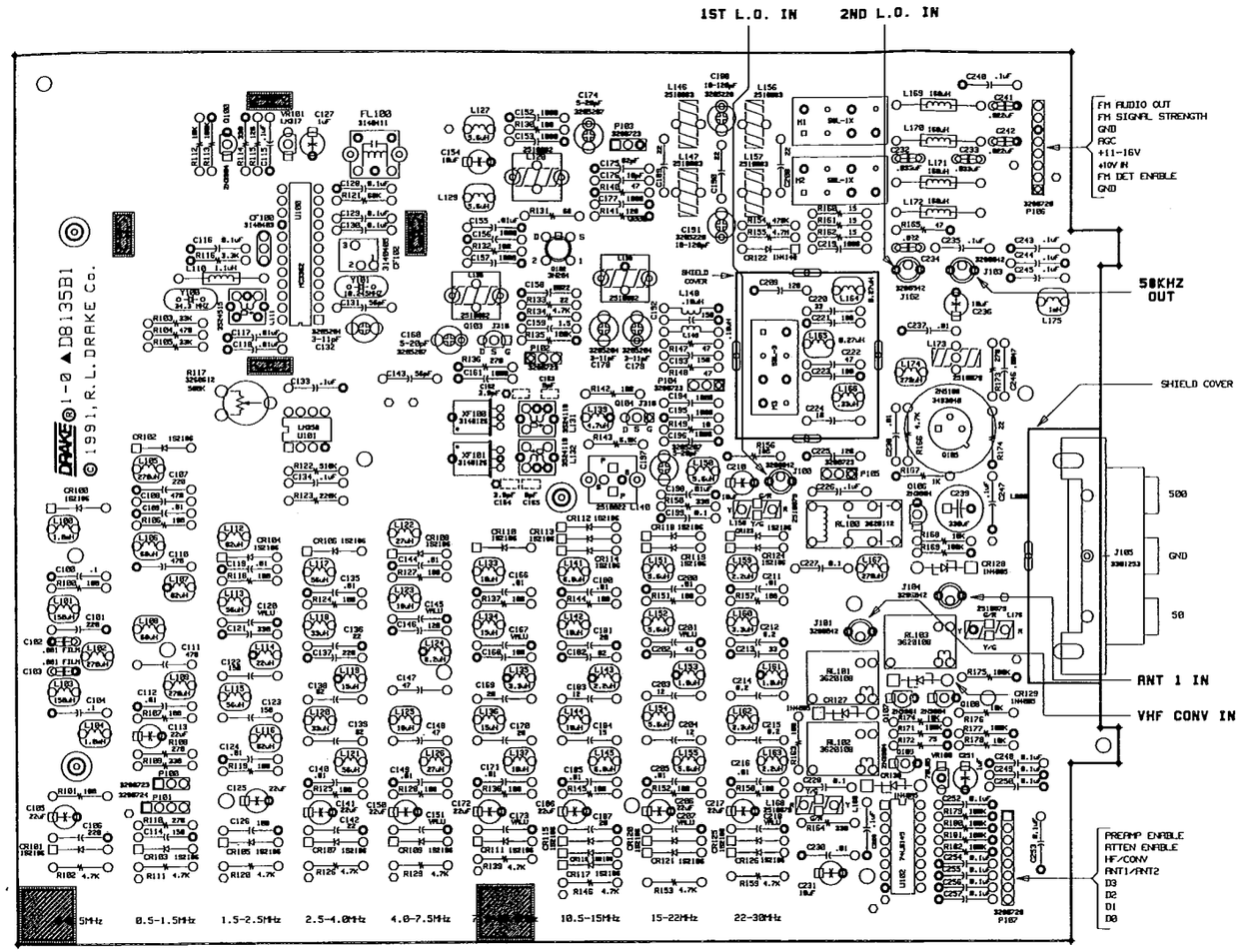
Note: This drawing applies to R8/R8E units with serial (S/N) numbers **previous to 11100000** (November 1991)



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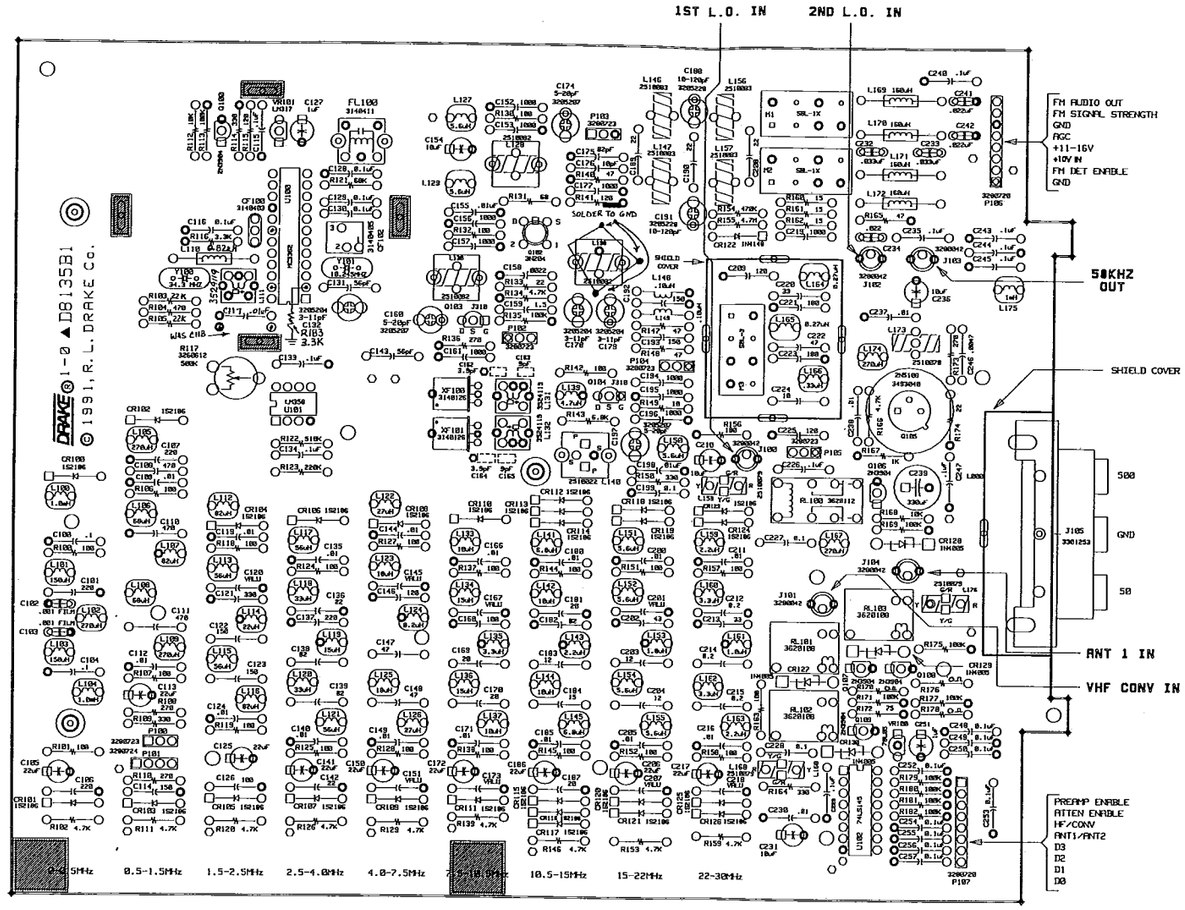

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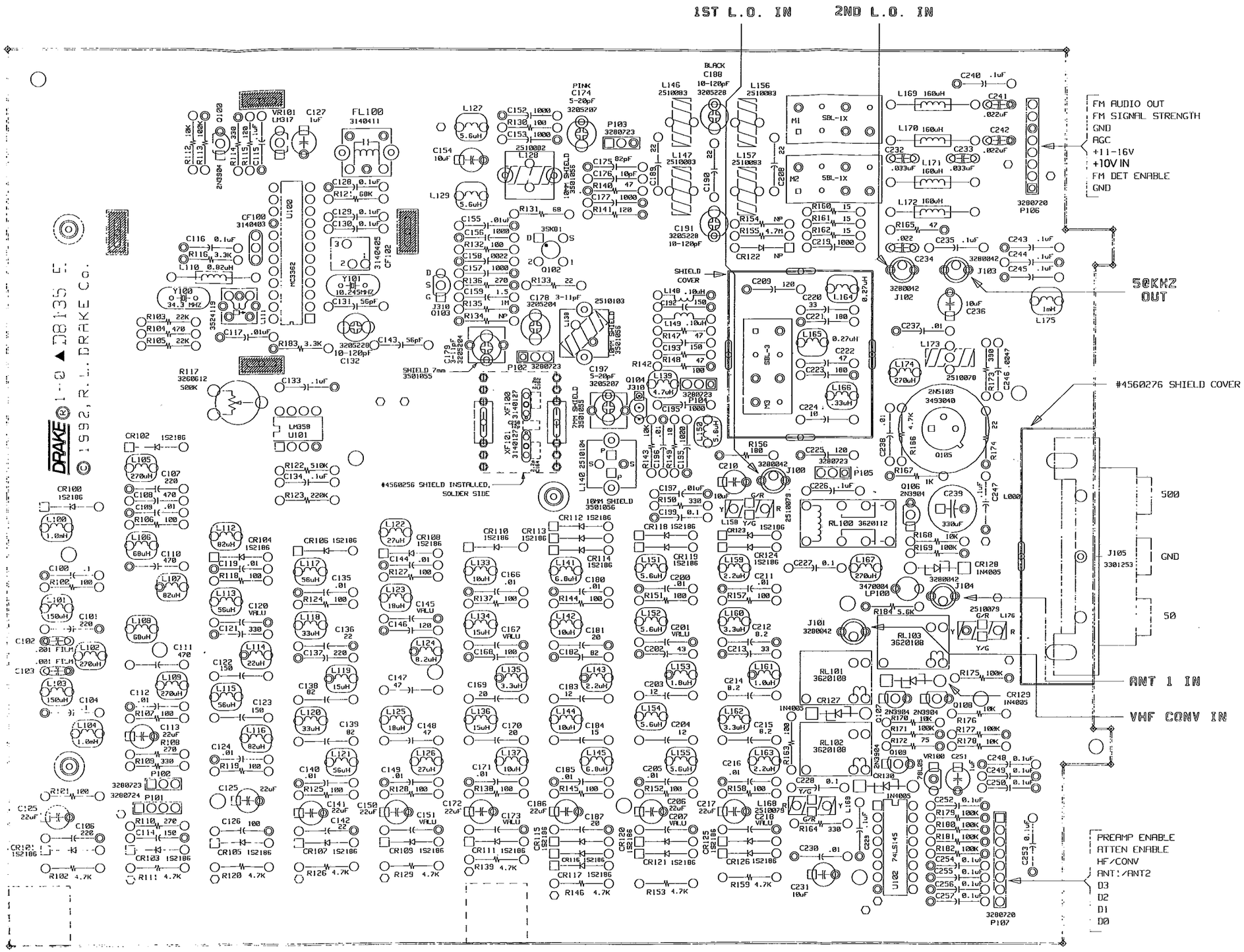
SCHEMATIC REF. D821I

ASSEMBLY PARTS, TOP SIDE VIEW.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILS. TOLERANCES ARE: MILS +/- 15; DECIMALS +/- .015; ANGLES +/- 1	JOB NO 930	DRAKE® R. L. DRAKE CO.	
MATERIAL .062 DS FR4 1 OZ CU BOTH SIDES	APPROVALS	DATE	R8 FRONT END
FINISH SOLDER PLATE	DRAWN J.GOEPPER	3-26-90	
DO NOT SCALE DRAWING	CHECKED		SIZE D; DWG. NO. 8135; REV. B2
	ISSUED		SCALE 1.5:1; PART NO. 2100830; SHEET 4 OF 4

Front End Board Pictorial D-8135

Note: This drawing applies to R8/R8E units with Revisions "D" and "E" printed circuit board artwork.



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THEORY OF OPERATION 2ND IF

1. Noise Blanker
2. Step Variable BPF
3. IF AMP and AGC Generator
4. AM and SSB Detectors
5. Audio Processing
6. -5V Generator

1. Noise Blanker

The noise blanker IC U117 incorporates internally an AGC'd amplifier strip, AGC control, peak detector, noise differentiator, time controlled RF gate, and time controlled audio hold circuits. Pin outs are provided for externally connected timing elements.

Noise bursts entering along with the IF signal are differentiated and trigger the RF gate off. Triggering threshold is raised by paralleling the differentiating cap C355 with a resistor. Switching a 1K resistor (R366) disables the triggering completely. Once triggered the gate off time is determined by the RF blank resistance (R362 and R361). The triggering of the RF gate is followed by the triggering of the audio hold after an externally programmed delay (R340) passes. The audio hold time, determined by R341 and C337, is selected to span the "hole" created after gating off the RF carrier.

2. Step Variable BPF

The BPF has five bandwidth selections which default in response to the mode of transmission selected (i.e. 6 KHz for AM). The other bandwidths can be envoked in sequence from the default BW. Pass band tuning can be utilized to skew the signal reception to either side of the passband center for improved channel rejection and/or frequency response.

The BPF results from the cascade of two four-pole Chebyshev (BPF) sections isolated by one stage of AGC'd amplification. Centered at 50 KHz, all bandwidths are designed around fixed inductor values of 9.5 mH. Coupling and shunt capacitor values are switched via analog gates (U111,113,114 and 115) and discrete transistors respectively. In addition, the loading of the filter is switched similarly. Switching a source resistor in the JFET amp stage preceeding the BPF compensates for the insertion loss of the 6 KHz bandwidth filter network.

3. IF AMP and AGC Generator

The AGC'd IF amplifier is comprised of three mosfet stages. Each stage has a different gain control time delay to insure stability of the loop. The output stage has the least and the input stage has the most delay. The gain control signal is generated as follows. The output of the last mosfet stage Q110 is rectified in the class "C" biased stage (Q130) which reduces the bias applied to the OP amp U116A. The output of U116A is applied directly through three individual delay networks to the 50 KHz mosfet stages. The mosfets employ reverse AGC (e.g. a negative going control signal reduces the gain). A fourth gain control path is buffered by a second OP-amp (U116B) which outputs to the 45 MHz mosfet stage on the "front end" board. The biasing of U116B allows its gain control signal to the front end to maximize the signal - to-noise ratio over the range of operation.

The "AGC OFF" circuitry shunts the IF output that would be rectified by Q130 and thus maintains maximum gain as set by the front panel control. The mute circuitry rebiases the OP-amps to the negative supply thus maintaining minimum gain. AGC fast/slow circuitry switches a resistor (R303) in and out of the delay network at the output of Q130. The "S" meter drive current is derived from the AGC output and is shaped via diodes and variable resistors so that the meter accurately displays received signal strength.

The external muting feature is accomplished by applying ground to J103, the rear panel mute jack. Grounding J103 turns Q150 off thereby turning Q151 off which forces the AGC line to -5 VDC. The net result is full AGC on the IF amplifier stages reducing IF gain to its minimum level. Q149 and associated components provide for an automatic mute when power is first applied to the receiver to permit the active AGC level to be established smoothly.

4. AM and SSB Detectors

The 50 KHz signal splits into two paths following the last MOSFET stage (Q110). One path enters the double balanced demodulator IC (U103) and the other enters a carrier limiter and regenerator strip to provide carrier port injection to U103 for AM mode detection. Carrier limiting is provided through a linear stage (Q108) and a digital gate (U109A). The output symmetry/threshold of the digital gate is set by a variable resistor (R158) in the positive feedback network of U109A. The limited carrier is split into two paths at the Q109A stage. One path is coupled thru R150 and CR101 to the carrier input of U103 for non-synchronous AM detection. CR101 conducts in this AM detection mode since the 'BFO ENABLE' line is low and the 'SYNCH DET' line is high which holds Q101 and Q102 in an OFF state. Since pin 12 of U108 is at a high state with the limited carrier clocking pin 11 of U108, the 'Q' output is high, thereby turning Q104 to an ON state which prevents any 100 KHz carrier (Synchronous mode) from being applied to pin 3 of U108. With pin 9 of U108 in a high state, pin 8 is in a low state which grounds CR104 and keeps CR102 reverse biased as additional isolation to any 50 KHz regenerated carrier at pin 5 of U108. Note also, with the logic high state applied to the 'SYNCH DET' line, Q140, Q132 and Q162 are ON. This condition provides a short time constant to the PLL generated 100 KHz local carrier (U112) to permit relatively fast acquisition of the carrier if the synchronous mode of detection is selected.

For synchronous AM detection, the 'SYNCH DET' line is driven to a logic low by the system microprocessor and related circuitry. The 'BFO ENA' line remains in a logic low state as for AM detection. The limited 50 KHz carrier is doubled by U109B & D and applied to the 100 KHz PLL circuit (U112) which can provide an uninterrupted carrier that frequency tracks the original. Note that Q140, Q132 and Q162 are OFF, thereby providing a long time constant to the PLL generated 100 KHz local carrier. With Q104 OFF, three succeeding stages of U110 phase shift the (100 KHz) PLL carrier and apply it to the clock input pin 3 of U108. The output signal at pin 5 of U108 is (divided by two) a 50 KHz synchronous carrier that is conducted thru CR102 to the carrier input of U103. Pin 8 of U108 is a logic high which results in a reverse biased CR104 and a +5 VDC level applied thru R189 to illuminate the front panel 'SYNCHRO' LED.

For SSB operation, the 'BFO ENA' line is set at a logic high state which turns Q101 ON, thereby clamping the limited carrier input of U109A to 0.7 VDC and setting the output of U109A to zero. The logic high on the 'BFO ENA' line inhibits the PLL circuit, U112. Also, with Q102 turned ON, Q104 is ON and no output is possible from U110. With no limited carrier or synchronous locally generated carrier present at the junction of CR101 and CR102, the 50 KHz BFO carrier from J109 is sent to the carrier input of U103.

Regardless of the detection mode, the demodulated audio is present at pin 6 of U103.

5. Audio Processing

The detected audio from the demodulator IC passes through the audio hold circuit of the noise blanker IC. The hold function is only available in the AM mode. Leaving the hold circuit, the audio passes through the tone control circuit (U106), which allows ±10 dB boost and cut of the bass response.

The audio notch follows the tone control. The notching frequency is made variable by employing a variable BPF (U107B) in a split signal network that cancels at the BP center frequency. The notch is disabled by switching off the signal to the BPF.

The audio then enters the squelch gate (U105A). The squelch reference is the buffered AGC line from (U102B) and the squelch trip point is set via the front panel control. The squelch trip signal selects a terminated input resulting in muted audio. This selector IC feeds the AM or FM audio to a buffer (U107A) and 5 KHz low pass filter (U100A). The output of the LPF is split into three paths: two buffered line audio outputs and a volume controlled audio power amp (U104). The output of the power amp passes through the headphone jack before switching between the internal and/or external speaker (s).

6. -5 VDC Generator

The -5 volt supply is utilized in the MOSFET gain control circuitry. It is generated by a free running 115 KHz multivibrator oscillator composed of crosscoupled transistor stages Q116 and Q121. Transistor stage Q120 provides reliable pullup to the 10V supply on positive excursions of the output signal. Q120 also provides reliable startup of the oscillator due to the initial charging of C231. When +10 volts supply is applied, C231 begins charging until a level sufficient to turn on Q121 is reached. The action of turning on Q121 turns Q116 and Q120 off which in turn sends a pulse thru C230 to turn Q120 on and the cycle begins again. The resulting output pulses are rectified by CR116 and CR124 and applied to filter capacitor C299. A zener diode CR123 regulates the output voltage to -5 VDC. The output is further filtered by C253 and L110 prior to being sent to the AGC circuits.

SECOND IF BOARD PARTS LIST

REF	PART NUM	DESCRIPTION
C100	3180064	CAP ELECTRO 10@50 20%
C101	3180109	CAP ELECTRO 22@25 20%
C102	3180018	CAP ELECTRO 2.2@50
C103	3151650	CAP AX .1 MF 100V MET.FILM
C104	3180109	CAP ELECTRO 22@25 20%
C105	3151425	CAP AXIAL .0022MF 20% Y5P
C106	3151433	CAP AXIAL .0033MF 20% Y5R
C107	3151459	CAP AX .0047MF +80-20 Z5U
C108	3151040	CAP AXIAL 82.0 PF 5% N750
C109	3180064	CAP ELECTRO 10@50 20%
C110	3151515	CAP AXIAL .01 MF 20% Y5P
C111	3180018	CAP ELECTRO 2.2@50
C112	3180109	CAP ELECTRO 22@25 20%
C113	3180241	CAP ELECTRO 470@16
C114	3180012	CAP ELECTRO 1@50 20%
C115	3151648	CAP AX .10 MF 50V
C116	3184060	CAP FILM .047 @ 50V 5%
C117	3180018	CAP ELECTRO 2.2@50
C118	3180064	CAP ELECTRO 10@50 20%
C119	3151648	CAP AX .10 MF 50V
C120	3151648	CAP AX .10 MF 50V
C121	3180018	CAP ELECTRO 2.2@50
C122	3180018	CAP ELECTRO 2.2@50
C123	3151648	CAP AX .10 MF 50V
C124	3151648	CAP AX .10 MF 50V
C125	3180239	CAP ELECTRO 470@25 RADIAL
C126	3180239	CAP ELECTRO 470@25 RADIAL
C127	3180018	CAP ELECTRO 2.2@50
C128	3180018	CAP ELECTRO 2.2@50
C129	3180064	CAP ELECTRO 10@50 20%
C130	3180064	CAP ELECTRO 10@50 20%
C131	3151065	CAP AXIAL 100 PF 5% GP
C132	3180064	CAP ELECTRO 10@50 20%
C133	3151648	CAP AX .10 MF 50V
C134	3150690	CAP AXIAL 33.0 PF 5% NPO
C135	3150690	CAP AXIAL 33.0 PF 5% NPO
C136	3151405	CAP AXIAL .001 MF 10% Y5P
C137	3151587	CAP AX .047 MF +80-20 Z5U
C138	3180064	CAP ELECTRO 10@50 20%
C139	3151260	CAP RADIAL 220 PF 5% N470
C140	3184039	CAP FILM .015 @ 100V 5%
C141	3180064	CAP ELECTRO 10@50 20%
C142	3184150	CAP FILM 2.2 @ 100V 10%
C143	3180348	CAP ELECTRO 6800@25 RAD'L
C144	3180348	CAP ELECTRO 6800@25 RAD'L
C145	3151648	CAP AX .10 MF 50V
C146	3180018	CAP ELECTRO 2.2@50
C147	3180018	CAP ELECTRO 2.2@50
C148	3180064	CAP ELECTRO 10@50 20%
C149	3151432	CAP RAD. .0033MF 2% NPO
C150	3151433	CAP AXIAL .0033MF 20% Y5R
C151	3180064	CAP ELECTRO 10@50 20%
C152	3180152	CAP ELECTRO 100@50
C153	3151648	CAP AX .10 MF 50V
C154	3180064	CAP ELECTRO 10@50 20%
C155	3184019	CAP FILM .001 @ 100V 5%
C156	3180064	CAP ELECTRO 10@50 20%
C157	3151648	CAP AX .10 MF 50V
C158	3150690	CAP AXIAL 33.0 PF 5% NPO
C159	3151405	CAP AXIAL .001 MF 10% Y5P
C160	3150690	CAP AXIAL 33.0 PF 5% NPO
C161	3151405	CAP AXIAL .001 MF 10% Y5P
C162	3151648	CAP AX .10 MF 50V
C163	3151050	CAP AXIAL 91.0 PF 2% NPO
C164	3151405	CAP AXIAL .001 MF 10% Y5P
C165	3151405	CAP AXIAL .001 MF 10% Y5P
C166	3151364	CAP AXIAL 680 PF 2% NPO
C168	3151064	CAP AXIAL 100 PF 2% NPO
C169	3150420	CAP AXIAL 12.0 PF 5% NPO
C170	3150783	CAP AXIAL 51.0 PF 2% NPO
C171	3150750	CAP AXIAL 39.0 PF 5% NPO
C172	3150420	CAP AXIAL 12.0 PF 5% NPO
C173	3150420	CAP AXIAL 12.0 PF 5% NPO
C174	3150540	CAP AXIAL 18.0 PF 5% NPO
C175	3150779	CAP AXIAL 43.0 PF 5% NPO
C176	3150640	CAP AXIAL 27.0 PF 5% NPO
C177	3151405	CAP AXIAL .001 MF 10% Y5P
C178	3151425	CAP AXIAL .0022MF 20% Y5P
C179	3151648	CAP AX .10 MF 50V
C180	3180018	CAP ELECTRO 2.2@50
C181	3184019	CAP FILM .001 @ 100V 5%
C182	3180109	CAP ELECTRO 22@25 20%
C183	3180109	CAP ELECTRO 22@25 20%
C184	3180152	CAP ELECTRO 100@50
C185	3151648	CAP AX .10 MF 50V
C186	3180018	CAP ELECTRO 2.2@50
C187	3151050	CAP AXIAL 91.0 PF 2% NPO
C188	3151405	CAP AXIAL .001 MF 10% Y5P
C189	3151405	CAP AXIAL .001 MF 10% Y5P
C190	3151364	CAP AXIAL 680 PF 2% NPO
C191	3151260	CAP RADIAL 220 PF 5% N470
C193	3151425	CAP AXIAL .0022MF 20% Y5P
C194	3151260	CAP RADIAL 220 PF 5% N470
C195	3151155	CAP AXIAL 150 PF 10% Y5P
C196	3180018	CAP ELECTRO 2.2@50
C197	3180064	CAP ELECTRO 10@50 20%
C198	3150245	CAP AXIAL 6.8 PF 10% NPO
C199	3151260	CAP RADIAL 220 PF 5% N470
C200	3180018	CAP ELECTRO 2.2@50
C201	3180241	CAP ELECTRO 470@16
C202	3180109	CAP ELECTRO 22@25 20%
C203	3180109	CAP ELECTRO 22@25 20%
C204	3180018	CAP ELECTRO 2.2@50
C205	3180064	CAP ELECTRO 10@50 20%
C206	3150245	CAP AXIAL 6.8 PF 10% NPO
C207	3150640	CAP AXIAL 27.0 PF 5% NPO
C208	3150779	CAP AXIAL 43.0 PF 5% NPO
C209	3150540	CAP AXIAL 18.0 PF 5% NPO
C210	3150420	CAP AXIAL 12.0 PF 5% NPO
C211	3150420	CAP AXIAL 12.0 PF 5% NPO
C212	3150750	CAP AXIAL 39.0 PF 5% NPO
C213	3150783	CAP AXIAL 51.0 PF 2% NPO
C214	3151064	CAP AXIAL 100 PF 2% NPO

22 Second IF Board Parts List cont'd.

REF	PART NUM	DESCRIPTION
C215	3150420	CAP AXIAL 12.0 PF 5% NPO
C216	3151648	CAP AX .10 MF 50V
C217	3180018	CAP ELECTRO 2.2@50
C218	3150420	CAP AXIAL 12.0 PF 5% NPO
C219	3150690	CAP AXIAL 33.0 PF 5% NPO
C220	3150750	CAP AXIAL 39.0 PF 5% NPO
C221	3150350	CAP AXIAL 10.0 PF 5% NPO
C222	3151405	CAP AXIAL .001 MF 10% Y5P
C223	3151260	CAP RADIAL 220 PF 5% N470
C224	3151364	CAP AXIAL 680 PF 2% NPO
C225	3151065	CAP AXIAL 100 PF 5% GP
C226	3151295	CAP AXIAL 330 PF 10% Y5P
C227	3151648	CAP AX .10 MF 50V
C228	.3180241	CAP ELECTRO 470@16
C229	3151405	CAP AXIAL .001 MF 10% Y5P
C230	3151405	CAP AXIAL .001 MF 10% Y5P
C231	3151362	CAP AXIAL 680 PF 10% Y5P
C232	3151648	CAP AX .10 MF 50V
C233	3150420	CAP AXIAL 12.0 PF 5% NPO
C234	3150640	CAP AXIAL 27.0 PF 5% NPO
C235	3150750	CAP AXIAL 39.0 PF 5% NPO
C236	3150350	CAP AXIAL 10.0 PF 5% NPO
C237	3151405	CAP AXIAL .001 MF 10% Y5P
C238	3151364	CAP AXIAL 680 PF 2% NPO
C239	3151260	CAP RADIAL 220 PF 5% N470
C240	3151648	CAP AX .10 MF 50V
C241	3151064	CAP AXIAL 100 PF 2% NPO
C242	3150640	CAP AXIAL 27.0 PF 5% NPO
C243	3150540	CAP AXIAL 18.0 PF 5% NPO
C244	3151405	CAP AXIAL .001 MF 10% Y5P
C245	3151364	CAP AXIAL 680 PF 2% NPO
C246	3150168	CAP AXIAL 5.6 PF 10% NPO
C247	3150896	CAP AXIAL 56.0 PF 5% NPO
C248	3151648	CAP AX .10 MF 50V
C249	3151648	CAP AX .10 MF 50V
C250	3151648	CAP AX .10 MF 50V
C251	3151648	CAP AX .10 MF 50V
C252	3151425	CAP AXIAL .0022MF 20% Y5P
C253	3180152	CAP ELECTRO 100@50
C254	3151362	CAP AXIAL 680 PF 10% Y5P
C255	3151648	CAP AX .10 MF 50V
C256	3151648	CAP AX .10 MF 50V
C257	3150900	CAP AXIAL 68 PF 2% NPO
C258	3150640	CAP AXIAL 27.0 PF 5% NPO
C259	3150540	CAP AXIAL 18.0 PF 5% NPO
C260	3150350	CAP AXIAL 10.0 PF 5% NPO
C261	3150896	CAP AXIAL 56.0 PF 5% NPO
C262	3151405	CAP AXIAL .001 MF 10% Y5P
C263	3151364	CAP AXIAL 680 PF 2% NPO
C264	3150168	CAP AXIAL 5.6 PF 10% NPO
C265	3151260	CAP RADIAL 220 PF 5% N470
C266	3150245	CAP AXIAL 6.8 PF 10% NPO
C267	3151648	CAP AX .10 MF 50V
C268	3151648	CAP AX .10 MF 50V
C269	3151648	CAP AX .10 MF 50V
C270	3151648	CAP AX .10 MF 50V
C271	3180018	CAP ELECTRO 2.2@50
C272	3180064	CAP ELECTRO 10@50 20%
C273	3150420	CAP AXIAL 12.0 PF 5% NPO
C274	3150750	CAP AXIAL 39.0 PF 5% NPO
C275	3150640	CAP AXIAL 27.0 PF 5% NPO
C276	3150350	CAP AXIAL 10.0 PF 5% NPO
C277	3151405	CAP AXIAL .001 MF 10% Y5P
C278	3151364	CAP AXIAL 680 PF 2% NPO
C279	3151260	CAP RADIAL 220 PF 5% N470
C280	3151260	CAP RADIAL 220 PF 5% N470
C281	3150245	CAP AXIAL 6.8 PF 10% NPO
C282	3151064	CAP AXIAL 100 PF 2% NPO
C283	3150420	CAP AXIAL 12.0 PF 5% NPO
C284	3150783	CAP AXIAL 51.0 PF 2% NPO
C285	3150750	CAP AXIAL 39.0 PF 5% NPO
C286	3150420	CAP AXIAL 12.0 PF 5% NPO
C287	3150420	CAP AXIAL 12.0 PF 5% NPO
C288	3150540	CAP AXIAL 18.0 PF 5% NPO
C289	3150779	CAP AXIAL 43.0 PF 5% NPO
C290	3150640	CAP AXIAL 27.0 PF 5% NPO
C293	3180018	CAP ELECTRO 2.2@50
C294	3151515	CAP AXIAL .01 MF 20% Y5P
C295	3151515	CAP AXIAL .01 MF 20% Y5P
C296	3180109	CAP ELECTRO 22@25 20%
C297	3180109	CAP ELECTRO 22@25 20%
C298	3180064	CAP ELECTRO 10@50 20%
C299	3180109	CAP ELECTRO 22@25 20%
C300	3180018	CAP ELECTRO 2.2@50
C301	3151648	CAP AX .10 MF 50V
C302	3180064	CAP ELECTRO 10@50 20%
C303	3150420	CAP AXIAL 12.0 PF 5% NPO
C304	3150750	CAP AXIAL 39.0 PF 5% NPO
C305	3150640	CAP AXIAL 27.0 PF 5% NPO
C306	3150350	CAP AXIAL 10.0 PF 5% NPO
C307	3151405	CAP AXIAL .001 MF 10% Y5P
C308	3151364	CAP AXIAL 680 PF 2% NPO
C309	3150595	CAP AXIAL 22.0 PF 5% NPO
C310	3151260	CAP RADIAL 220 PF 5% N470
C311	3150640	CAP AXIAL 27.0 PF 5% NPO
C312	3150779	CAP AXIAL 43.0 PF 5% NPO
C313	3150540	CAP AXIAL 18.0 PF 5% NPO
C314	3150420	CAP AXIAL 12.0 PF 5% NPO
C315	3150420	CAP AXIAL 12.0 PF 5% NPO
C316	3150750	CAP AXIAL 39.0 PF 5% NPO
C317	3150783	CAP AXIAL 51.0 PF 2% NPO
C318	3150420	CAP AXIAL 12.0 PF 5% NPO
C319	3151064	CAP AXIAL 100 PF 2% NPO
C320	3151050	CAP AXIAL 91.0 PF 2% NPO
C321	3151648	CAP AX .10 MF 50V
C322	3180064	CAP ELECTRO 10@50 20%
C323	3151515	CAP AXIAL .01 MF 20% Y5P
C324	3180018	CAP ELECTRO 2.2@50
C325	3151515	CAP AXIAL .01 MF 20% Y5P
C326	3151345	CAP AXIAL 470 PF 10% Y5P
C327	3151515	CAP AXIAL .01 MF 20% Y5P
C328	3180002	CAP ELECTRO .22@50 L.LEAK
C329	3180002	CAP ELECTRO .22@50 L.LEAK
C330	3151405	CAP AXIAL .001 MF 10% Y5P
C331	3151405	CAP AXIAL .001 MF 10% Y5P
C332	3180064	CAP ELECTRO 10@50 20%
C333	3180007	CAP ELECTRO .47@50
C334	3180064	CAP ELECTRO 10@50 20%
C335	3151648	CAP AX .10 MF 50V
C336	3151648	CAP AX .10 MF 50V
C337	3151432	CAP RAD. .0033MF 2% NPO

REF	PART NUM	DESCRIPTION
C338	3180064	CAP ELECTRO 10@50 20%
C339	3180064	CAP ELECTRO 10@50 20%
C340	3151648	CAP AX .10 MF 50V
C341	3180064	CAP ELECTRO 10@50 20%
C342	3151648	CAP AX .10 MF 50V
C343	3180064	CAP ELECTRO 10@50 20%
C344	3151515	CAP AXIAL .01 MF 20% Y5P
C345	3180064	CAP ELECTRO 10@50 20%
C346	3151515	CAP AXIAL .01 MF 20% Y5P
C347	3180064	CAP ELECTRO 10@50 20%
C348	3180018	CAP ELECTRO 2.2@50
C349	3151065	CAP AXIAL 100 PF 5% GP
C350	3151065	CAP AXIAL 100 PF 5% GP
C351	3151425	CAP AXIAL .0022MF 20% Y5P
C352	3151648	CAP AX .10 MF 50V
C353	3151345	CAP AXIAL 470 PF 10% Y5P
C354	3180152	CAP ELECTRO 100@50
C355	3180012	CAP ELECTRO 1@50 20%
C356	3180018	CAP ELECTRO 2.2@50
C357	3151515	CAP AXIAL .01 MF 20% Y5P
C358	3180241	CAP ELECTRO 470@16
C359	3151259	CAP AXIAL 220pF, 10%, Y5P
C360	3151405	CAP AXIAL .001 MF, 10%, Y5P
C361	3151515	CAP AXIAL .01 MF, 20%, Y5P
CR100	3020090	DIODE 1N4148
CR101	3020090	DIODE 1N4148
CR102	3020090	DIODE 1N4148
CR103	3020090	DIODE 1N4148
CR104	3020090	DIODE 1N4148
CR105	3020090	DIODE 1N4148
CR106	3024811	DIODE 6A2
CR107	3024811	DIODE 6A2
CR108	3024811	DIODE 6A2
CR109	3024811	DIODE 6A2
CR110	3020220	DIODE 1N4005-PLASTIC
CR111	3024811	DIODE 6A2
CR112	3020090	DIODE 1N4148
CR113	3020090	DIODE 1N4148
CR114	3020220	DIODE 1N4005-PLASTIC
CR115	3020220	DIODE 1N4005-PLASTIC
CR116	3020401	DIODE 1SS97-2-ND4973-7E
CR118	3020090	DIODE 1N4148
CR119	3020090	DIODE 1N4148
CR120	3020050	DIODE 1N751A 5.1V 5% .5W
CR121	3020220	DIODE 1N4005-PLASTIC
CR122	3020220	DIODE 1N4005-PLASTIC
CR123	3020050	DIODE 1N751A 5.1V 5% .5W
CR124	3020401	DIODE 1SS97-2-ND4973-7E
CR125	3020090	DIODE 1N4148
CR126	3020050	DIODE 1N751A 5.1V 5% .5W
CR127	3020090	DIODE 1N4148
CR128	3020090	DIODE 1N4148
CR129	3020090	DIODE 1N4148
CR130	3020090	DIODE 1N4148
CR131	3020090	DIODE 1N4148
CR132	3020401	DIODE 1SS97-2-ND4973-7E
CR133	3020090	DIODE 1N4148
CR134	3020220	DIODE 1N4005-PLASTIC
CR135	3020090	DIODE 1N4148
CR136	3020090	DIODE 1N4148

REF	PART NUM	DESCRIPTION
HS1	2150019	HT.SINK(5073B)-TDA2003 ASSY
J100	3281025	JACK PHONE #YKB21-5012
J101	3281695	RECEPTACLE PHONO 1P PC MT
J102	3281695	RECEPTACLE PHONO 1P PC MT
J103	3281695	RECEPTACLE PHONO 1P PC MT
J104	3281505	RECEPTACLE DIN 5 PIN
J105	3280042	CONN.COAX PC MT. 90 DEG
J106	3280746	CONN P.C. 8 PIN FEMALE
J107	3280746	CONN P.C. 8 PIN FEMALE
J108	3280746	CONN P.C. 8 PIN FEMALE
J109	3280043	CONN.COAX PC MT. 45 DEG
L100	2055127	9.5mH POT CORE ASSY (4560254 SHIELD)
L101	3524114	COIL VAR 10.0 MH 10% C11265
L102	3524241	COIL RAD'L 47 MH C7679 (SCL)
L103	2055127	9.5mH POT CORE ASSY (4560254 SHIELD)
L104	3520590	CHOKE ASSY 270.0 UH
L105	2055127	9.5mH POT CORE ASSY (4560254 SHIELD)
L106	3524241	COIL RAD'L 47 MH C7679 (SCL)
L107	2055127	9.5mH POT CORE ASSY (4560254 SHIELD)
L108	2055127	9.5mH POT CORE ASSY (4560254 SHIELD)
L109	2055127	9.5mH POT CORE ASSY (4560254 SHIELD)
L110	3520590	CHOKE ASSY 270.0 UH
L111	2055127	9.5mH POT CORE ASSY (4560254 SHIELD)
L112	2055127	9.5mH POT CORE ASSY (4560254 SHIELD)
L113	3524241	COIL RAD'L 47 MH C7679 (SCL)
P100	3280723	CONN P.C. 3 PIN MALE
P101	3280723	CONN P.C. 3 PIN MALE
P102	3280723	CONN P.C. 3 PIN MALE
P103	3280723	CONN P.C. 3 PIN MALE
P105	3290752	CONN P.C. LG 2 PIN MALE
P106	3280723	CONN P.C. 3 PIN MALE
P107	3280723	CONN P.C. 3 PIN MALE
P108	3280723	CONN P.C. 3 PIN MALE
P109	3290752	CONN P.C. LG 2 PIN MALE
P110	3280723	CONN P.C. 3 PIN MALE
P111	3280723	CONN P.C. 3 PIN MALE
P112	3280723	CONN P.C. 3 PIN MALE
P113	3280720	CONN P.C. 8 PIN MALE
Q100	3030104	TRANSISTOR 2N3904
Q101	3030104	TRANSISTOR 2N3904
Q102	3030104	TRANSISTOR 2N3904
Q103	3030104	TRANSISTOR 2N3904
Q104	3030104	TRANSISTOR 2N3904
Q105	3030495	TRANSISTOR J270
Q106	3030292	TRANSISTOR MPSA13
Q107	3030104	TRANSISTOR 2N3904
Q108	3030104	TRANSISTOR 2N3904
Q109	3030286	TRANSISTOR 3SK81
Q110	3030286	TRANSISTOR 3SK81
Q111	3030104	TRANSISTOR 2N3904
Q112	3030104	TRANSISTOR 2N3904
Q113	3030104	TRANSISTOR 2N3904

24 Second IF Board Parts List cont'd.

REF	PART NUM	DESCRIPTION
Q114	3030104	TRANSISTOR 2N3904
Q115	3030104	TRANSISTOR 2N3904
Q116	3030104	TRANSISTOR 2N3904
Q117	3030104	TRANSISTOR 2N3904
Q118	3030104	TRANSISTOR 2N3904
Q119	3030104	TRANSISTOR 2N3904
Q120	3030111	TRANSISTOR 2N4125
Q121	3030104	TRANSISTOR 2N3904
Q122	3030104	TRANSISTOR 2N3904
Q123	3030104	TRANSISTOR 2N3904
Q124	3030104	TRANSISTOR 2N3904
Q125	3030104	TRANSISTOR 2N3904
Q126	3030104	TRANSISTOR 2N3904
Q127	3030104	TRANSISTOR 2N3904
Q128	3030104	TRANSISTOR 2N3904
Q129	3030104	TRANSISTOR 2N3904
Q130	3030104	TRANSISTOR 2N3904
Q131	3030111	TRANSISTOR 2N4125
Q132	3030121	TRANSISTOR 2N4402
Q133	3030104	TRANSISTOR 2N3904
Q134	3030104	TRANSISTOR 2N3904
Q135	3030104	TRANSISTOR 2N3904
Q136	3030104	TRANSISTOR 2N3904
Q137	3030104	TRANSISTOR 2N3904
Q138	3030104	TRANSISTOR 2N3904
Q139	3030495	TRANSISTOR J270
Q140	3030104	TRANSISTOR 2N3904
Q141	3030104	TRANSISTOR 2N3904
Q142	3030104	TRANSISTOR 2N3904
Q143	3030104	TRANSISTOR 2N3904
Q144	3030104	TRANSISTOR 2N3904
Q145	3030104	TRANSISTOR 2N3904
Q146	3030104	TRANSISTOR 2N3904
Q147	3030104	TRANSISTOR 2N3904
Q148	3030292	TRANSISTOR MPSA13
Q149	3030104	TRANSISTOR 2N3904
Q150	3030104	TRANSISTOR 2N3904
Q151	3030111	TRANSISTOR 2N4125
Q152	3030104	TRANSISTOR 2N3904
Q153	3030104	TRANSISTOR 2N3904
Q154	3030104	TRANSISTOR 2N3904
Q155	3030286	TRANSISTOR 3SK81
Q156	3030104	TRANSISTOR 2N3904
Q157	3030504	TRANSISTOR J-310
Q158	3030104	TRANSISTOR 2N3904
Q159	3030104	TRANSISTOR 2N3904
Q160	3030104	TRANSISTOR 2N3904
Q161	3030111	TRANSISTOR 2N4125
Q162	3030201	TRANS 2N5953 TO92 (NS PACK.97)
R100	3220004	RES C.FILM 6.8 OHM 5%1/4W
R101	3220140	RES C.FILM 680 OHM 5%1/4W
R102	3220110	RES C.FILM 470 OHM 5%1/4W
R103	3220275	RES C.FILM 33 K 5% 1/4W
R104	3220275	RES C.FILM 33 K 5% 1/4W
R105	3220275	RES C.FILM 33 K 5% 1/4W
R106	3220235	RES C.FILM 10 K 5% 1/4W
R107	3220315	RES C.FILM 100 K 5% 1/4W
R108	3220235	RES C.FILM 10 K 5% 1/4W
R109	3220200	RES C.FILM 3.3 K 5% 1/4W
R110	3220275	RES C.FILM 33 K 5% 1/4W
R111	3220200	RES C.FILM 3.3 K 5% 1/4W

REF	PART NUM	DESCRIPTION
R112	3220160	RES C.FILM 1.0 K 5% 1/4W
R113	3220330	RES C.FILM 220 K 5% 1/4W
R114	3220310	RES C.FILM 82 K 5% 1/4W
R115	3260672	RES VAR PT10V 50K
R116	3220235	RES C.FILM 10 K 5% 1/4W
R117	3220235	RES C.FILM 10 K 5% 1/4W
R118	3220235	RES C.FILM 10 K 5% 1/4W
R119	3220160	RES C.FILM 1.0 K 5% 1/4W
R120	3220160	RES C.FILM 1.0 K 5% 1/4W
R121	3220145	RES C.FILM 820 OHM 5%1/4W
R122	3220160	RES C.FILM 1.0 K 5% 1/4W
R123	3220235	RES C.FILM 10 K 5% 1/4W
R124	3220195	RES C.FILM 2.7 K 5% 1/4W
R125	3220195	RES C.FILM 2.7 K 5% 1/4W
R126	3220170	RES C.FILM 1.2 K 5% 1/4W
R127	3220015	RES C.FILM 22 OHM 5%1/4W
R128	3220315	RES C.FILM 100 K 5% 1/4W
R129	3220285	RES C.FILM 47 K 5% 1/4W
R130	3220315	RES C.FILM 100 K 5% 1/4W
R131	3220045	RES C.FILM 68 OHM 5%1/4W
R132	3220006	RES C.FILM 1.5 OHM 5%1/4W
R133	3220235	RES C.FILM 10 K 5% 1/4W
R134	3220235	RES C.FILM 10 K 5% 1/4W
R135	3220160	RES C.FILM 1.0 K 5% 1/4W
R136	3220355	RES C.FILM 1.0 MEG 5%1/4W
R137	3220355	RES C.FILM 1.0 MEG 5%1/4W
R138	3220235	RES C.FILM 10 K 5% 1/4W
R139	3260688	RES VAR PT10V LIN 2K
R140	3220345	RES C.FILM 470 K 5% 1/4W
R141	3220115	RES C.FILM 510 OHM 5%1/4W
R142	3220090	RES C.FILM 330 OHM 5%1/4W
R143	3220240	RES C.FILM 12 K 5% 1/4W
R144	3220282	RES C.FILM 39 K 5% 1/4W
R145	3220315	RES C.FILM 100 K 5% 1/4W
R146	3220315	RES C.FILM 100 K 5% 1/4W
R147	3220235	RES C.FILM 10 K 5% 1/4W
R148	3220000	RES M.FILM 0.0 OHM 1%1/4W
R149	3220235	RES C.FILM 10 K 5% 1/4W
R150	3220160	RES C.FILM 1.0 K 5% 1/4W
R151	3220160	RES C.FILM 1.0 K 5% 1/4W
R152	3220160	RES C.FILM 1.0 K 5% 1/4W
R153	3220190	RES C.FILM 2.2 K 5% 1/4W
R154	3220190	RES C.FILM 2.2 K 5% 1/4W
R155	3220350	RES C.FILM 680 K 5% 1/4W
R156	3220315	RES C.FILM 100 K 5% 1/4W
R157	3220285	RES C.FILM 47 K 5% 1/4W
R158	3260672	RES VAR PT10V 50K
R159	3220315	RES C.FILM 100 K 5% 1/4W
R161	3220300	RES C.FILM 68 K 5% 1/4W
R162	3220275	RES C.FILM 33 K 5% 1/4W
R164	3220315	RES C.FILM 100 K 5% 1/4W
R165	3220235	RES C.FILM 10 K 5% 1/4W
R166	3220295	RES C.FILM 56 K 5% 1/4W
R167	3220235	RES C.FILM 10 K 5% 1/4W
R168	3220230	RES C.FILM 8.2 K 5% 1/4W
R169	3220235	RES C.FILM 10 K 5% 1/4W
R170	3220170	RES C.FILM 1.2 K 5% 1/4W
R171	3220215	RES C.FILM 5.6 K 5% 1/4W
R172	3220000	RES M.FILM 0.0 OHM 1%1/4W
R173	3220315	RES C.FILM 100 K 5% 1/4W
R174	3220075	RES C.FILM 220 OHM 5%1/4W
R175	3220005	RES C.FILM 10 OHM 5%1/4W

REF	PART NUM	DESCRIPTION
R176	3220240	RES C.FILM 12 K 5% 1/4W
R177	3220235	RES C.FILM 10 K 5% 1/4W
R178	3220285	RES C.FILM 47 K 5% 1/4W
R179	3220235	RES C.FILM 10 K 5% 1/4W
R180	3220315	RES C.FILM 100 K 5% 1/4W
R181	3220315	RES C.FILM 100 K 5% 1/4W
R182	3250487	RES M.FILM 100 K 1% 1/4 W
R183	3250488	RES M.FILM 200 K 1% 1/4 W
R184	3260668	RES VAR PT10V 20K
R185	3220090	RES C.FILM 330 OHM 5%1/4W
R186	3220210	RES C.FILM 4.7 K 5% 1/4W
R187	3220200	RES C.FILM 3.3 K 5% 1/4W
R188	3220245	RES C.FILM 15 K 5% 1/4W
R189	3220175	RES C.FILM 1.5 K 5% 1/4W
R190	3220065	RES C.FILM 150 OHM 5%1/4W
R191	3220000	RES M.FILM 0.0 OHM 1%1/4W
R192	3220160	RES C.FILM 1.0 K 5% 1/4W
R193	3220275	RES C.FILM 33 K 5% 1/4W
R194	3220345	RES C.FILM 470 K 5% 1/4W
R195	3220230	RES C.FILM 8.2 K 5% 1/4W
R196	3220295	RES C.FILM 56 K 5% 1/4W
R197	3220345	RES C.FILM 470 K 5% 1/4W
R198	3220295	RES C.FILM 56 K 5% 1/4W
R199	3220352	RES C.FILM 820 K 5% 1/4W
R200	3220235	RES C.FILM 10 K 5% 1/4W
R201	3220235	RES C.FILM 10 K 5% 1/4W
R202	3220380	RES C.FILM 10 MEG 10%1/4W
R203	3220275	RES C.FILM 33 K 5% 1/4W
R204	3220300	RES C.FILM 68 K 5% 1/4W
R205	3220310	RES C.FILM 82 K 5% 1/4W
R206	3220295	RES C.FILM 56 K 5% 1/4W
R208	3220235	RES C.FILM 10 K 5% 1/4W
R209	3260612	RES VAR PT10V LIN 500K
R210	3220190	RES C.FILM 2.2 K 5% 1/4W
R211	3220075	RES C.FILM 220 OHM 5%1/4W
R212	3220315	RES C.FILM 100 K 5% 1/4W
R213	3220315	RES C.FILM 100 K 5% 1/4W
R214	3220345	RES C.FILM 470 K 5% 1/4W
R215	3220235	RES C.FILM 10 K 5% 1/4W
R216	3220235	RES C.FILM 10 K 5% 1/4W
R217	3220380	RES C.FILM 10 MEG 10%1/4W
R218	3220275	RES C.FILM 33 K 5% 1/4W
R219	3220300	RES C.FILM 68 K 5% 1/4W
R220	3220310	RES C.FILM 82 K 5% 1/4W
R221	3220295	RES C.FILM 56 K 5% 1/4W
R222	3220330	RES C.FILM 220 K 5% 1/4W
R223	3220040	RES C.FILM 56 OHM 5%1/4W
R224	3220315	RES C.FILM 100 K 5% 1/4W
R225	3220040	RES C.FILM 56 OHM 5%1/4W
R226	3220205	RES C.FILM 3.9 K 5% 1/4W
R227	3220045	RES C.FILM 68 OHM 5%1/4W
R228	3220045	RES C.FILM 68 OHM 5%1/4W
R229	3220235	RES C.FILM 10 K 5% 1/4W
R230	3220235	RES C.FILM 10 K 5% 1/4W
R231	3220380	RES C.FILM 10 MEG 10%1/4W
R232	3220260	RES C.FILM 22 K 5% 1/4W
R233	3220260	RES C.FILM 22 K 5% 1/4W
R234	3220260	RES C.FILM 22 K 5% 1/4W
R235	3220260	RES C.FILM 22 K 5% 1/4W
R236	3220275	RES C.FILM 33 K 5% 1/4W
R237	3220260	RES C.FILM 22 K 5% 1/4W
R238	3220235	RES C.FILM 10 K 5% 1/4W
R239	3220275	RES C.FILM 33 K 5% 1/4W
R240	3220260	RES C.FILM 22 K 5% 1/4W
R241	3220235	RES C.FILM 10 K 5% 1/4W
R242	3220235	RES C.FILM 10 K 5% 1/4W
R243	3220260	RES C.FILM 22 K 5% 1/4W
R244	3220275	RES C.FILM 33 K 5% 1/4W
R245	3220005	RES C.FILM 10 OHM 5%1/4W
R246	3220235	RES C.FILM 10 K 5% 1/4W
R247	3220235	RES C.FILM 10 K 5% 1/4W
R248	3220355	RES C.FILM 1.0 MEG 5%1/4W
R249	3220210	RES C.FILM 4.7 K 5% 1/4W
R250	3220235	RES C.FILM 10 K 5% 1/4W
R251	3220235	RES C.FILM 10 K 5% 1/4W
R252	3220275	RES C.FILM 33 K 5% 1/4W
R253	3220235	RES C.FILM 10 K 5% 1/4W
R254	3220235	RES C.FILM 10 K 5% 1/4W
R255	3220380	RES C.FILM 10 MEG 10%1/4W
R256	3220260	RES C.FILM 22 K 5% 1/4W
R257	3220260	RES C.FILM 22 K 5% 1/4W
R258	3220260	RES C.FILM 22 K 5% 1/4W
R259	3220260	RES C.FILM 22 K 5% 1/4W
R260	3220235	RES C.FILM 10 K 5% 1/4W
R261	3220260	RES C.FILM 22 K 5% 1/4W
R262	3220275	RES C.FILM 33 K 5% 1/4W
R263	3220275	RES C.FILM 33 K 5% 1/4W
R264	3220260	RES C.FILM 22 K 5% 1/4W
R265	3220235	RES C.FILM 10 K 5% 1/4W
R266	3220275	RES C.FILM 33 K 5% 1/4W
R267	3220260	RES C.FILM 22 K 5% 1/4W
R268	3220235	RES C.FILM 10 K 5% 1/4W
R269	3220235	RES C.FILM 10 K 5% 1/4W
R270	3220380	RES C.FILM 10 MEG 10%1/4W
R272	3220260	RES C.FILM 22 K 5% 1/4W
R273	3220260	RES C.FILM 22 K 5% 1/4W
R274	3220260	RES C.FILM 22 K 5% 1/4W
R275	3220260	RES C.FILM 22 K 5% 1/4W
R276	3220245	RES C.FILM 15 K 5% 1/4W
R277	3220275	RES C.FILM 33 K 5% 1/4W
R278	3220255	RES C.FILM 18 K 5% 1/4W
R280	3220340	RES C.FILM 330 K 5% 1/4W
R281	3220160	RES C.FILM 1.0 K 5% 1/4W
R282	3220235	RES C.FILM 10 K 5% 1/4W
R283	3220235	RES C.FILM 10 K 5% 1/4W
R284	3220090	RES C.FILM 330 OHM 5%1/4W
R285	3260664	RES VAR PT10V 10K
R286	3220315	RES C.FILM 100 K 5% 1/4W
R287	3220315	RES C.FILM 100 K 5% 1/4W
R288	3220275	RES C.FILM 33 K 5% 1/4W
R289	3220315	RES C.FILM 100 K 5% 1/4W
R290	3220235	RES C.FILM 10 K 5% 1/4W
R291	3220380	RES C.FILM 10 MEG 10%1/4W
R292	3220260	RES C.FILM 22 K 5% 1/4W
R293	3220260	RES C.FILM 22 K 5% 1/4W
R294	3220260	RES C.FILM 22 K 5% 1/4W
R295	3220260	RES C.FILM 22 K 5% 1/4W
R296	3220275	RES C.FILM 33 K 5% 1/4W
R297	3220245	RES C.FILM 15 K 5% 1/4W
R298	3220235	RES C.FILM 10 K 5% 1/4W
R299	3220235	RES C.FILM 10 K 5% 1/4W
R300	3220295	RES C.FILM 56 K 5% 1/4W
R302	3220365	RES C.FILM 3.3 MEG 5%1/4W

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REF	PART NUM	DESCRIPTION
R303	3220355	RES C.FILM 1.0 MEG 5%1/4W
R304	3220384	RES C.FILM 12 MEG 10%1/4W
R305	3220360	RES C.FILM 2.2 MEG 5%1/4W
R306	3220235	RES C.FILM 10 K 5% 1/4W
R307	3220315	RES C.FILM 100 K 5% 1/4W
R308	3220315	RES C.FILM 100 K 5% 1/4W
R309	3220060	RES C.FILM 120 OHM 5%1/4W
R310	3220235	RES C.FILM 10 K 5% 1/4W
R311	3220295	RES C.FILM 56 K 5% 1/4W
R312	3220315	RES C.FILM 100 K 5% 1/4W
R313	3220245	RES C.FILM 15 K 5% 1/4W
R314	3220315	RES C.FILM 100 K 5% 1/4W
R315	3220000	RES M.FILM 0.0 OHM 1%1/4W
R316	3220345	RES C.FILM 470 K 5% 1/4W
R317	3220315	RES C.FILM 100 K 5% 1/4W
R318	3220090	RES C.FILM 330 OHM 5%1/4W
R319	3220215	RES C.FILM 5.6 K 5% 1/4W
R320	3220215	RES C.FILM 5.6 K 5% 1/4W
R321	3220235	RES C.FILM 10 K 5% 1/4W
R322	3220235	RES C.FILM 10 K 5% 1/4W
R323	3220275	RES C.FILM 33 K 5% 1/4W
R324	3220160	RES C.FILM 1.0 K 5% 1/4W
R325	3260688	RES VAR PT10V LIN 2K
R327	3220212	RES C.FILM 5.1 K 5% 1/4W
R328	3220235	RES C.FILM 10 K 5% 1/4W
R329	3220275	RES C.FILM 33 K 5% 1/4W
R330	3220275	RES C.FILM 33 K 5% 1/4W
R331	3220275	RES C.FILM 33 K 5% 1/4W
R332	3220190	RES C.FILM 2.2 K 5% 1/4W
R333	3220195	RES C.FILM 2.7 K 5% 1/4W
R334	3220235	RES C.FILM 10 K 5% 1/4W
R335	3220235	RES C.FILM 10 K 5% 1/4W
R336	3260664	RES VAR PT10V 10K
R337	3220205	RES C.FILM 3.9 K 5% 1/4W
R338	3220195	RES C.FILM 2.7 K 5% 1/4W
R339	3220240	RES C.FILM 12 K 5% 1/4W
R340	3220357	RES C.FILM 1.5 MEG 5%1/4W
R341	3220315	RES C.FILM 100 K 5% 1/4W
R342	3220200	RES C.FILM 3.3 K 5% 1/4W
R343	3220235	RES C.FILM 10 K 5% 1/4W
R344	3220235	RES C.FILM 10 K 5% 1/4W
R345	3220190	RES C.FILM 2.2 K 5% 1/4W
R346	3220315	RES C.FILM 100 K 5% 1/4W
R347	3220140	RES C.FILM 680 OHM 5%1/4W
R348	3220090	RES C.FILM 330 OHM 5%1/4W
R349	3220315	RES C.FILM 100 K 5% 1/4W
R350	3220090	RES C.FILM 330 OHM 5%1/4W
R351	3220140	RES C.FILM 680 OHM 5%1/4W
R352	3220235	RES C.FILM 10 K 5% 1/4W
R353	3220200	RES C.FILM 3.3 K 5% 1/4W
R354	3220315	RES C.FILM 100 K 5% 1/4W
R355	3220315	RES C.FILM 100 K 5% 1/4W
R356	3220320	RES C.FILM 150 K 5% 1/4W
R357	3220370	RES C.FILM 4.7 MEG 5%1/4W
R358	3220345	RES C.FILM 470 K 5% 1/4W
R359	3220065	RES C.FILM 150 OHM 5%1/4W
R360	3220040	RES C.FILM 56 OHM 5%1/4W
R361	3220335	RES C.FILM 270 K 5% 1/4W
R362	3220355	RES C.FILM 1.0 MEG 5%1/4W
R363	3260668	RES VAR PT10V 20K
R364	3220245	RES C.FILM 15 K 5% 1/4W
R365	3220230	RES C.FILM 8.2 K 5% 1/4W
R366	3220160	RES C.FILM 1.0 K 5% 1/4W
R367	3220235	RES C.FILM 10 K 5% 1/4W
R368	3220235	RES C.FILM 10 K 5% 1/4W
R369	3220285	RES C.FILM 47 K 5% 1/4W
R370	3220315	RES C.FILM 100 K 5% 1/4W
R371	3220235	RES C.FILM 10 K 5% 1/4W
R373	3220055	RES C.FILM 100 OHM 5%1/4W
R374	3260620	RES VAR PT10V LIN 100K
R375	3220317	RES C.FILM 120 K 5% 1/4W
R376	3220210	RES C.FILM 4.7 K 5% 1/4W
R377	3220205	RES C.FILM 3.9 K 5% 1/4W
R378	3220315	RES C.FILM 100 K 5% 1/4W
R379	3220315	RES C.FILM 100 K 5% 1/4W
R380	3220210	RES C.FILM 4.7 K 5% 1/4W
R381	3220315	RES C.FILM 100 K 5% 1/4W
R382	3260672	RES VAR PT10V 50K
R383	3220040	RES C.FILM 56 OHM 5%1/4W
R384	3220330	RES C.FILM 220 K 5% 1/4W
R385	3220145	RES C.FILM 820 K 5% 1/4W
R386	3220350	RES C.FILM 680 K 5% 1/4W
R387	3220315	RES C.FILM 100 K 5% 1/4W
RY100	3620112	RELAY TAKAMISAWA #RZ-12K
RY101	3620108	RELAY ITT #MZ12HG
SW100	3670541	SW SLIDE DP3T #SLY-23-05P
U100	3040097	I.C. LF353N
U102	3040131	I.C. MC3405
U103	3040112	I.C. 1496P
U104	3040551	I.C. TDA2003
U105	3041054	I.C. 14052
U106	3040094	I.C. LM358
U107	3040097	I.C. LF353N
U108	3040011	I.C. 74HC74
U109	3040033	I.C. 74HC86
U110	3040033	I.C. 74HC86
U111	3041054	I.C. 14052
U112	3040029	I.C. 74HC4046
U113	3041054	I.C. 14052
U114	3041054	I.C. 14052
U115	3041054	I.C. 14052
U116	3040094	I.C. LM358
U117	3040075	I.C. ULN3845A
VR100	3040031	I.C. 78LO5-ACP
VR101	3040164	I.C. 2940-10
VR102	3040160	I.C. 2940-5

2nd IF/Audio/Power Supply Board Schematic D-8212

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Note: This drawing applies to R8/R8E units with serial (S/N) numbers previous to 11100000 (November 1991)

NOISE BLANKER

AGC/ RF GAIN

BANDPASS FILTER 1

ALL NPN'S =2N3904
ALL CAPS IN PICOFARADS IN FILTER SECTIONS

BANDPASS FILTER 2

ALL NPN'S =2N3904
ALL CAPS IN PICOFARADS IN FILTER SECTION

POWER SUPPLY

DC RESISTANCE CHECK USING VTVM		MIN. RESISTANCE
BETWEEN POINT A AND CHASSIS GND		2M OHMS
BETWEEN POINT B AND CHASSIS GND		2M OHMS
BETWEEN POINT C AND CHASSIS GND		8K OHMS

WARNING: PARTS WITHIN DOTTED LINE ARE CRITICAL WITH RESPECT TO RISK OF FIRE AND ELECTRIC SHOCK.

REMOVE FOR 220/240 VAC OPERATION IN EUROPE

F2 FUSE T400MA; T200MA

F1 FUSE 2A

100/120VAC 200/240VAC

VOLTAGE SELECT SWITCH

4 X 6A20

THERMAL CIRCUIT BREAKER

T1

NOTE: +10V SUPPLIES ARE SWITCHED (SW'D) UNLESS OTHERWISE NOTED.

SYNCHRONOUS DETECTOR

SSB/AM DETECTOR

TONE

SQUELCH

NOTCH

LPF

AUDIO AMP

-5V GENERATOR

LAST USED DES.	
RESISTOR	R383
CAPACITOR	C355
INDUCTOR	L113
TRANSISTOR	Q162

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2nd IF/Audio/Power Supply Board Schematic D-8212

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Note: This drawing applies to R8/R8E units with revision "H" printed circuit board artwork.

NOISE BLANKER

AGC/ RF GAIN

BANDPASS FILTER 1

ALL NPN'S =2N3904
ALL CAPS IN PICOFARADS
IN FILTER SECTIONS

BANDPASS FILTER 2

ALL NPN'S =2N3904
ALL CAPS IN PICOFARADS
IN FILTER SECTION

POWER SUPPLY

DC RESISTANCE CHECK USING VTVM

		MIN. RESISTANCE
BETWEEN POINT A AND CHASSIS GND		2M OHMS
BETWEEN POINT B AND CHASSIS GND		2M OHMS
BETWEEN POINT C AND CHASSIS GND		8K OHMS

WARNING: PARTS WITHIN DOTTED LINE ARE CRITICAL WITH RESPECT TO RISK OF FIRE AND ELECTRIC SHOCK.

NOTE: +10V SUPPLIES ARE SWITCHED (SW'D) UNLESS OTHERWISE NOTED.

SYNCHRONOUS DETECTOR

SSB/AM DETECTOR

TONE

SQUELCH

NOTCH

LPF

AUDIO AMP

-5V GENERATOR

LAST USED DES.	
RESISTOR	R387
CAPACITOR	C361
INDUCTOR	L113
TRANSISTOR	Q162

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2nd IF/Audio/Power Supply Board Schematic D-8212

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Note: This drawing applies to R8/R8E units with serial (S/N) numbers **after** 11100001 (November 1991)

NOISE BLANKER

AGC/ RF GAIN

BANDPASS FILTER 1

ALL NPN'S =2N3904
ALL CAPS IN PICOFARADS
IN FILTER SECTIONS

BANDPASS FILTER 2

ALL NPN'S =2N3904
ALL CAPS IN PICOFARADS
IN FILTER SECTION

POWER SUPPLY

SYNCHRONOUS DETECTOR

SSB/AM DETECTOR

TONE

SQUELCH

NOTCH

-5V GENERATOR

LPF

AUDIO AMP

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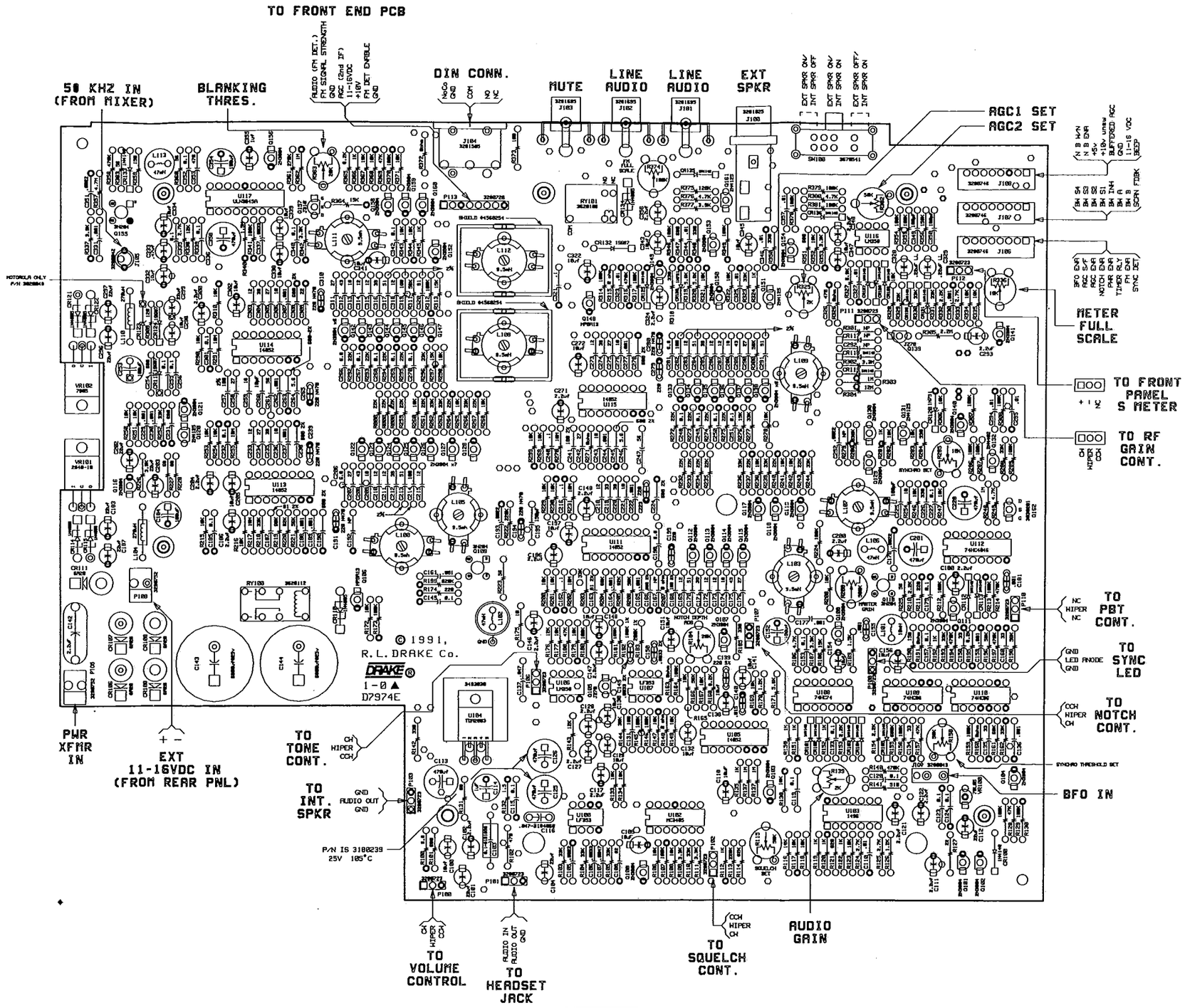
2nd IF/Audio/Power Supply Board Pictorial D-7974

Note: This drawing applies to R8/R8E units with serial (S/N) numbers **previous to 11100000** (November 1991)



NOTES

1. Q162 2N5482 (2030200) MAY BE REPLACED WITH 2N5953 (3030201), BUT BODY ROTATION WILL BE DIFFERENT. SEE CHART AT RIGHT FOR MORE INFORMATION.
2. C149 AND C150 MUST BE 2% PARTS AS NOTED (ZONE M-14)

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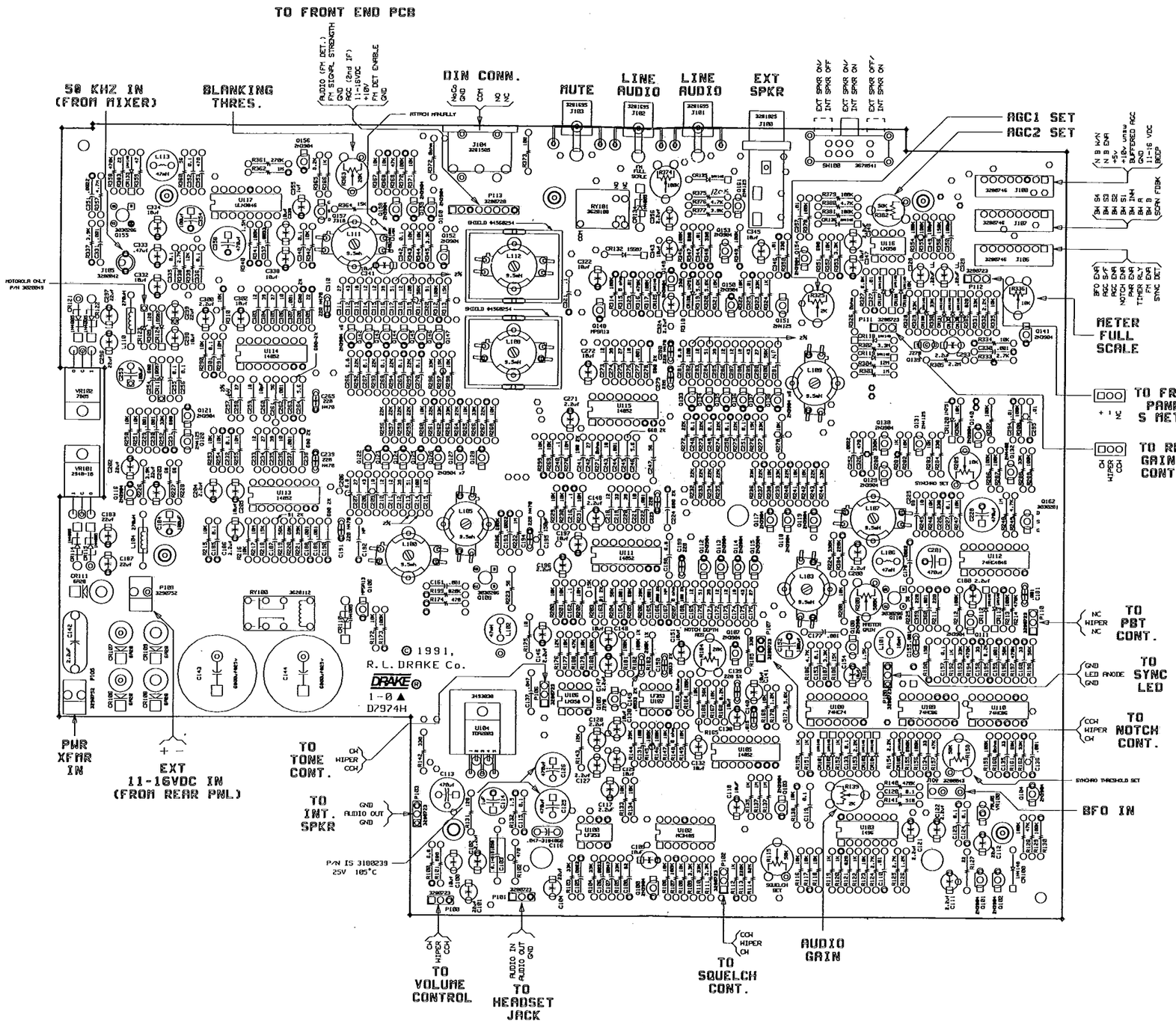
2nd IF/Audio/Power Supply Board Pictorial D-7974

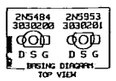
28

Note: This drawing applies to R8/R8E units with serial (S/N) numbers **after** 11100001 (November 1991)



NOTES

1. Q162 2N5482 (2030200) MAY BE REPLACED WITH 2N5953 (3030201), BUT BODY ROTATION WILL BE DIFFERENT. SEE CHART AT RIGHT FOR MORE INFORMATION.
2. C149 AND C150 MUST BE 2% PARTS AS NOTED (ZONE M-14)



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2nd IF/Audio/Power Supply Board Pictorial D-7974

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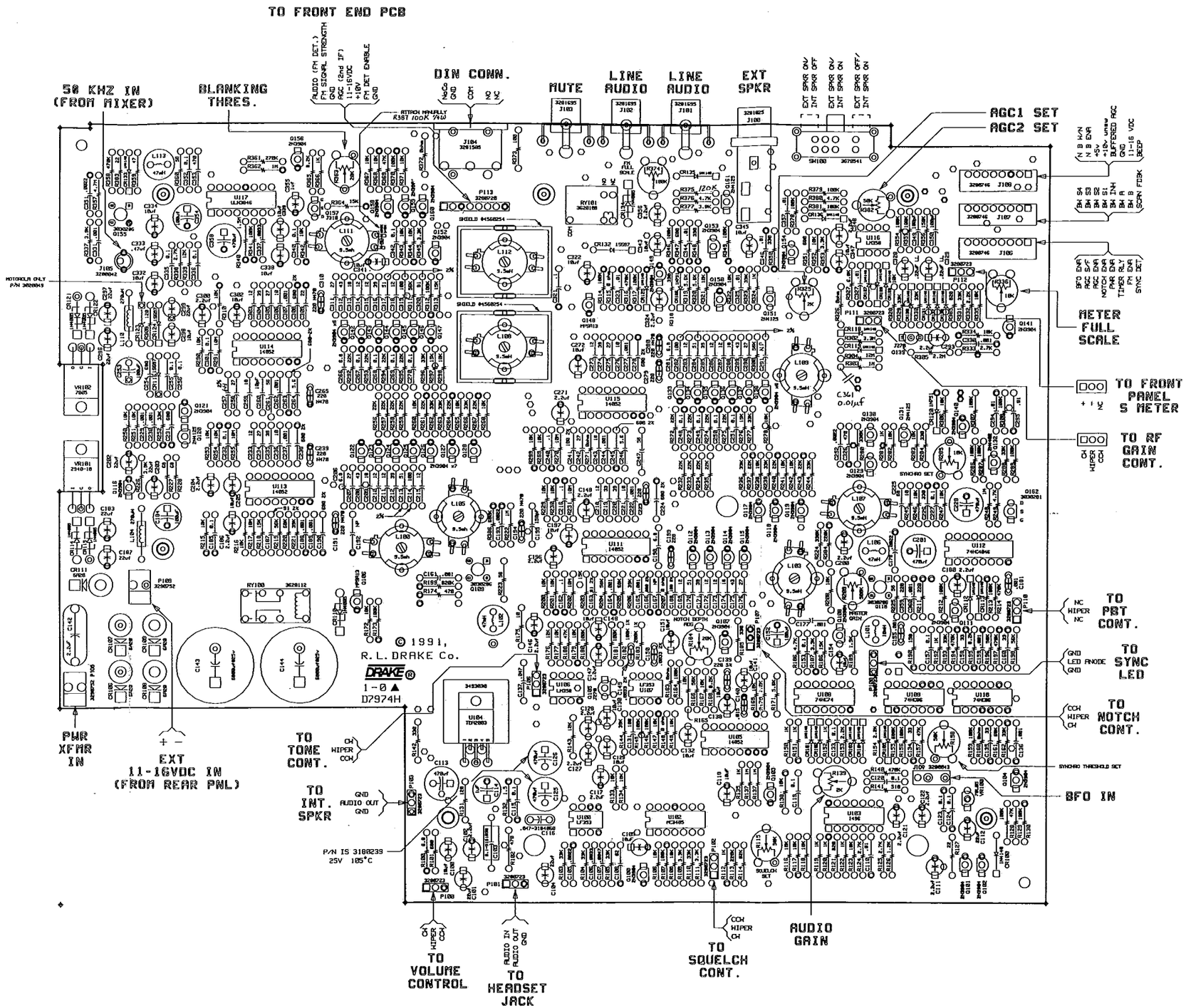
Note: This drawing applies to R8/R8E units with Revision "H" printed circuit board artwork.



NOTES

1. Q162 2N5402 (2030200) MAY BE REPLACED WITH 2N5953 (3030201), BUT BODY ROTATION WILL BE DIFFERENT. SEE CHART AT RIGHT FOR MORE INFORMATION.
2. C149 AND C150 MUST BE 2% PARTS AS NOTED (ZONE M-14)

2N5484 2N5953
3030200 3030201
D S G D S G
BASING DIAGRAM TOP VIEW

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SYNTHESIZER/MICROPROCESSOR THEORY OF OPERATION

The synthesizer/microprocessor board provides several RF signals and all the logic control signals required by other boards in the R8/R8E receiver. The RF signals provided by the synth/µP board include:

1) VCO or 1st LO which is a 45-75 MHz signal to the 1st mixer on the Front End board.
2) 2nd LO which is a 45.05 MHz signal to the 2nd mixer on the Front End board.
3) BFO or beat frequency oscillator which is a 50 KHz signal required for SSB reception by the AM detector on the 2nd IF/AUDIO/POWER SUPPLY board.
4) VHF REF which is a 3.5 MHz reference signal to the PLL on the optional VHF converter board.

Logic control signals required by other boards include:
1) Serial clock and data to the front panel display driver.
2) Front panel keyboard scanning.
3) Serial clock and data to optional VHF converter.
4) Latched, steady state control voltages to 2nd IF/AUDIO/POWER SUPPLY board for bandwidth selection, AGC ON/OFF and SLOW/FAST, Notch ON/OFF, Power ON/OFF etc.
5) Latched, steady state control voltages to Front End board for BPF selection, preamp/atten enable, ant 1/2/ converter.

Let's discuss the circuits involved with generating the 4 RF signals, beginning with the 1st LO. **Note that for most of the discussion that follows, the circuitry is located on the 'SYNTHESIZER CIRCUITS' schematic.**

1st LO

The VCO output or 1st LO is generated or synthesized by 3 nested phase locked loops (PLL'S), producing an injection signal that tunes from 45.1 MHz to 75.0 MHz in 10 Hz steps. This provides HF band reception from 100 KHz to 30 MHz in 10 Hz steps with the 1st IF frequency at 45.0 MHz.

Four distinct circuits are used to generate the 1st LO:
1) Reference oscillator
2) PLL3
3) PLL2
4) PLL1

Before discussing the specifics of these individual circuits, a brief overview of how the PLL circuits are interconnected is in order.

The PLL's are nested such that the inner most loop (PLL3) provides a reference signal to the middle loop (PLL2), and the middle loop provides a reference signal to the outer loop (PLL1). The inner loop VCO output is divided by 10 from approximately 65 MHz to 6.5 MHz by U122. This 6.5 MHz signal is used by the middle loop to lock the middle loop VCO on frequency. A 1 KHz step at 65 MHz becomes a 100 Hz step at 6.5 MHz and the middle loop VCO will move or shift 100 Hz.

Similarly, the middle loop VCO output is divided by 10 from approximately 60 MHz to 6.0 MHz by U123. This 6.0 MHz signal is used by the outer loop to lock the outer loop VCO on frequency. A 10 KHz step at 60 MHz becomes a 1 KHz step at 6.0 MHz and the outer loop VCO will move or shift 1 KHz. Likewise, a 1 KHz step in the inner loop becomes a 100 Hz step in the middle loop, which becomes a 10 Hz step at the outer loop VCO frequency. In other words, the middle loop tracks out any frequency changes in the inner loop, and the outer loop tracks out any changes in the middle loop. And the outer loop VCO frequency is the desired synthesized output.

REFERENCE OSCILLATOR

All three loops are phase locked to the highly stable, temperature compensated, crystal controlled, 35 MHz reference oscillator. The reference oscillator consists of a 35 MHz crystal (Y103), transistor Q140, and associated components. Resistors R299, R279 and R296 provide bias to the transistor. Capacitor C367 has a N750 temperature coefficient and provides the major temperature compensation. Variable inductor L155 provides the frequency tuning adjustment. Transistors Q137, Q141, Q139 and associated components provide buffering and reverse isolation.

For the outer loop (PLL1), the 35 MHz is routed through capacitor C363, coax W1 and capacitor C172 to U109 Pin 8. For PLL2 and PLL3, the reference frequency is divided by 10 from 35 MHz to 3.5 MHz by U130. This 3.5 MHz reference signal is coupled to PLL2, U126 Pin 1, through capacitor C316 and to PLL3, U125 Pin 1, through C314. The 3.5 MHz signal is also the reference signal for the optional VHF converter. This signal path will be discussed later.

Additionally, the 35 MHz reference is used in each loop to mix or translate signals to appropriate frequencies. In the outer loop, U117 uses the 35 MHz reference to translate the output of the middle loop from 6.0 MHz to 41.0 MHz. Similarily, in PLL2 and PLL3, U121 and U128 use 70 MHz to translate signals. The 70 MHz is obtained by doubling the frequency of the 35 MHz reference. The 35 MHz to 70 MHz doubler circuit consists of diode CR124, variable coil L154, transistor Q138 and associated components.

INNER LOOP PLL3

PLL3 is the inner most loop and provides the smallest step size and finest resolution. Its main component is U125: MC145157. U125 consists of 2 programmable dividers and a phase comparator. The programmable dividers are programmed by the µP through the serial data bus. The reference signal at Pin 1 is divided by R3. The VCO signal at Pin 8 is divided by N3. Since R3 is constant, the µP loads R3 only during the power-on sequence which is initiated by depressing the front panel power button. N3 is variable and needs to be loaded whenever the frequency changes. A 1 KHz step is achieved by changing N3. The step size of PLL3 is determined by the reference signal into Pin 1 of U125 and the division ratio R3 as follows:

Step size = reference frequency divided by R3.
The reference signal at Pin 1 is 3.5 MHz, and R3 = 3500, giving a minimum step size of 1 KHz. This also represents the frequency at which the phase comparator inside U125 compares the VCO signal at Pin 8 to the reference signal.

The output of the phase comparator is a DC tuning voltage at Pin 5 used to tune the VCO. The tuning voltage is filtered by the loop filter, a LPF consisting of U124, R229, R228, C280 and C281. The loop filter output voltage at Pin 7 of U124, is applied to varactors CR118 and CR119 in the VCO. This VCO, VC03, consisting of transistors Q124 and associated components, tunes from 65.001 MHz to 65.100 MHz in 1 KHz steps. Capacitors C250, C251, C253, C254, variable inductor L134 and varactors CR118 and CR119 determine the frequency of oscillation.

The VCO3 output is filtered by a LPF and buffered by Q130 and Q122. After Q130, the VCO3 output is mixed with 70 MHz at U128 and translated from the 65.001-65.100 MHz range to the 4.999-4.900 MHz range. The 4.999-4.900 MHz signal is the VCO signal presented to U125 Pin 8. A 5 MHz LPF after U128 filters off the undesired mixing products and Q132 provides enough gain to ensure U125 sees at least a 1 volt PTP signal at Pin 8.

U125 must divide the 4.999-4.900 MHz VCO signal down to 1 KHz for the internal phase comparison. This division ratio, N3, is calculated by the µP and loaded into U125. N3 will be an integer number within the following limits:

$4900 \leq N3 \leq 4999.$

Returning to the VCO3 output and Q122, after Q122 the VCO3 output is divided by 10 at U122. The output of U122 at Pin 4 is considered the PLL3 output. The PLL3 output signal covers the range from 6.5001 MHz to 6.5100 MHz in 100 Hz steps and is used by the middle loop (PLL2) to lock the middle loop VCO.

The frequency relationships of PLL3 are given by the following equations:

Let f_{REF} = 35 MHz reference signal

$$f_{VCO3} = 2 \times f_{REF} - f_{REF}/10 \times 1/R3 \times N3$$
$$= f_{ref} (2\text{-}N3/35000)$$

$$PLL3 = f_{VCO3} \div 10$$
$$= (f_{REF}/10) (2 - N3/35000)$$

MIDDLE LOOP PLL2

PLL2 is similar to PLL3 but provides the medium step size and resolution. Its main component is U126 : MC145157. U126 is identical to U125 in PLL3 and consists of 2 programmable dividers and a phase comparator. The programmable dividers are programmed by the µP through the serial data bus. The reference signal at Pin 1 is divided by R2. The VCO signal at Pin 8 is divided by N2. R2, like R3, is constant and the uP loads R2 only during the power-on sequence. N2, like N3, is variable and needs to be loaded whenever the frequency changes. A 10 KHz step is achieved by changing N2, and a 100 Hz step is obtained via PLL3. The step size of PLL2 is determined by the reference signal and R2:

Step size = ref signal/R2

The reference signal at Pin 1 is 3.5 MHz, R2 = 350, giving a PLL2 step size of 10 KHz. This also represents the frequency at which the phase comparison is performed inside U126.

The output of the phase comparator is a DC tuning voltage at Pin 5, and it is used to tune the VCO. The tuning voltage is filtered by the loop filter, a LPF consisting of U127, R230 and R231, C285 and C286. The loop filter output voltage at Pin 1 of U127, is applied to varactors CR121 and CR120 in the VCO. This VCO, VCO2, consisting of transistor Q125 and associated components, tunes from 60 to 61 MHz. Capacitors C258, C259, C261 and C262, variable inductor L135, and varactors CR120 and 121 determine the frequency of oscillation.

The VCO2 output is filtered by a LPF and buffered by Q123 and Q131. After Q131, the VCO2 output is mixed with a 63 MHz signal and translated to approximately 3 MHz by U129. The 63 MHz signal is directly related to the PLL3 frequency. The PLL3 output is mixed with 70 MHz at U121. A 63 MHz BPF selects the desired mixing product and completes the translation of the PLL3 output from the 6.5001 - 6.5100 MHz range to 63.4999 - 63.4900 MHz range. U129 mixes the 63.49 MHz signal and the 60-61 MHz VCO2 signal and produces a 2.50 - 3.49 MHz signal. A 4 MHz LPF after U129 filters off the undesired mixing product and Q133 provides enough gain to ensure U126 sees at least a 1V PTP signal at Pin 8.

The internal divider must divide the 2.50 - 3.49 MHz signal down to 10 KHz. This division ratio, N2, is calculated by the µP and loaded into U126. N2 will be an integer number within the following limits:

$$250 \leq N2 \leq 349$$

Returning to the VCO output and Q123, after Q123 the VCO2 output is divided by 10 at U123. The output of U123 at Pin 4 is considered the PLL2 output. The PLL2 output signal covers the range from 6.0 - 6.1 MHz in 10 Hz steps and is used by the outer loop PLL1 to lock the outer loop VCO.

The frequency relationships of PLL2 are given by the following equations:

$$\begin{aligned} f_{vco2} &= (2 \times (f_{ref}) - PLL3) - f_{ref}/10 \times 1/R2 \times N2 \\ &= 2 \times (f_{ref}) - (f_{ref}/10)(2 - N3/35000) - f_{ref}/10 \times 1/350 \times N2 \\ &= f_{ref}\,(2 - 1/10(2 - N3/35000) - N2/3500) \\ &= f_{ref}\,(1.8 + N3/350000 - N2/3500) \end{aligned}$$

$$\begin{aligned} PLL2 &= f_{vco2}/10 \\ &= (f_{ref}/10)(2 - 1/10\,(2 - N3/35000) - N2/3500) \\ &= (f_{ref})(1/10)(1.8 + N3/350000 - N2/3500) \\ &= f_{ref}\,(0.18 + N3/3500000 - N2/35000) \end{aligned}$$

OUTER LOOP PLL1

PLL1 is the outer phase-locked loop used to synthesize the 1st LO signal. The output signal of the outer loop VCO, VCO1, is the desired 1st LO signal. VCO1 is actually 4 different oscillators, each covering a different frequency band. The correct oscillator is selected and enabled by the µP control signals (VCO1 - VCO3). The main component in PLL1 is U109: MB87086. U109 is similar to U125 and U126, consisting of 2 programmable dividers and a phase comparator. The programmable dividers are programmed by the µP through the serial data bus. The reference signal at Pin 8 is divided by R1. The VCO signal at Pin 1 is divided by N1. R1, like R3 and R2, is constant and the µP loads R1 only during the power-on sequence. N1 is variable and needs to be updated whenever the frequency changes. A 100 KHz step is achieved by changing N1, and a 10 Hz step is obtained via PLL2.

The step size obtained by PLL1 is determined by the reference signal and R1:

Step size = ref signal ÷ R1

The reference signal at Pin 8 is 35 MHz, R1 = 350, resulting in a step size of 100 KHz. This also is the frequency at which the phase comparison is performed inside U109.

The output of the phase comparator is two pulsed control signals at Pins 15 and 16. Both control signals are normally at +5 volts and pulse low (0.2 volts) when active. The pulsewidth determines the amount of correction and is derived from the relative phase information. Pin 15 provides the "UP" pulse and Pin 16 is the "DOWN" pulse. The charge pump and loop filter produce a DC tuning voltage from the UP and DOWN pulses.

There are actually 2 different charge pump/loop filter combinations that tune the 4 oscillators of VCO1. The low band oscillator covers the range from 45.00000 to 52.49999 MHz, and has its own charge pump and loop filter. The low band oscillator consists of transistor Q107 and associated components. The low band charge pump consists of Q113, Q114 and Q115 and associated components. The low band loop filter consists of R170, C165 and C163.

The high band charge pump (Q116, Q117 and Q118) and the high band loop filter (R173, C169 and C170) tune the remaining 3 oscillators. Q108 tunes from 52.50000 to 59.99999 MHz; Q109 tunes from 60.00000 to 66.99999 MHz; and Q110 tunes from 67.00000 to 75.00000 MHz.

The VCO1 output is buffered by Q106 and filtered by a LPF. After the LPF, the signal path branches into two directions. Q111, Q100 and Q101 provide gain and reverse isolation at J100. J100 is the 1st LO output port to the front end board. Q112 and Q119 buffer the VCO1 to U116. The VCO1 output is mixed with a 41 MHz signal and translated from the 45.1 - 75.0 MHz range to the 4.1 - 34.0 MHz range by U116. The 41 MHz signal is directly related to the PLL2 frequency. The PLL2 output is mixed with 35 MHz at U117. A 41 MHz BPF selects the desired mixing product and completes the translation of the PLL2 output from the 6.0 - 6.1 MHz range to the 41.0 - 41.1 MHz range. A 35 MHz LPF after U116 filters off the undesired mixing products. Q120 and Q121 provide enough gain to ensure U109 sees at least 1 volt PTP at Pin 1.

The programmable divider inside U109 must divide the 4.1 - 34.0 MHz signal down to 100 KHz. This division ratio, N1, is calculated by the µP and loaded into U109.

N1 will be an integer number within the following limits:
$41 \leq N1 \leq 340$

The frequencies in PLL 1 are as follows:

$$\begin{aligned} f_{vco1} &= \text{desired 1st LO output} \\ &= f_{ref}/R1 \times N1 + (f_{ref} + PLL2) \\ &= f_{ref}\,(N1/350) + f_{ref} + f_{ref}\,(0.18 + N3/3.5E6 - N2/3.5E4) \\ &= f_{ref}\,(1.18 + N1/350 - N2/3.5E4 + N3/3.5E6) \end{aligned}$$

2nd LO/PBT (PASS BAND TUNING)

The 2nd LO is a 45.05 MHz signal that is sent to the Front End board and digital mixer circuit. The 2nd LO frequency actually varies depending on mode and front panel PBT adjustment, thus providing IF shifting . The 45.05 MHz signal is produced by doubling a varactor tuned, crystal controlled 22.525 MHz oscillator. The oscillator consists of a 22.525 MHz crystal (Y102), transistor Q126 and associated components. It is not referenced back to the 35 MHz reference signal thus requiring its its own temperature compensation. Capacitor C268 has a N1500 temperature coefficient and provides the major temperature compensation. Variable coil L131 provides the frequency tuning adjustment. Varactor CR117 provides a fine tune frequency adjustment. Fine tuning can be accomplished in two ways:

1) Front panel PBT adjustment
2) µP controlled DAC

Note that in the following text, circuit references to digital control can be located on the 'MICROPROCESSOR CIRCUITS' schematic.

The front panel PBT control is a user adjustment which provides approximately ± 2.5 KHz shift at 45.05 MHz. The µP controlled DAC provides programmable offsets which can be different for each mode.

The µP controlled DAC for PBT tuning is actually a variable gain amplifier. U103 (MN5450), under uP control through the serial data bus, switches a combination of 8 precision 1% resistors to ground changing the gain of amp U110A: (LM358). Each mode (AM, CW, USB, etc.) can be programmed with a unique combination, allowing a different factory programmed PBT frequency for each mode. Additional tuning is available to the user through the front panel PBT adjustment which sets a reference voltage at U110A Pin 3. Both DAC and front panel PBT changes will affect the tuning voltage output at U110A Pin 1.

Q128 and Q129 disable the 45.05 MHz signal when in the FM mode. Tuned circuits around L138, L139, L141, L151 and L152 are tuned to 45.05 MHz thus enhancing the 2nd harmonic. L140 allows the signal to be split into two paths. Q135 amplifies the 45.05 MHz signal which is then coupled to J107. Connector J107 is the 2nd LO output port to the front end board. Q134 amplifies the 45.05 MHz signal which is coupled into the digital mixer circuit.

BFO/DIGITAL MIXER

The digital mixer combines the 45.05 MHz 2nd LO signal and the 35 MHz reference signal to produce the 50 KHz BFO signal. The BFO signal is used in CW, RTTY, USB and LSB modes. Because the BFO signal is directly related to the 45.05 MHz signal, as the PBT is varied, the operating frequency does not change but rather IF shifting occurs.

Q142 amplifies the 35 MHz reference signal to the 4.5 volt PTP levels required by the digital integrated circuits. Likewise, Q143 amplifies the 45.05 MHz signal to 4.5 volts PTP. U132D mixes 35 MHz and 45.05 MHz and produces 10.05 MHz at Pin 11. U131 and U132A combine to divide the 35 MHz reference signal by 7 producing a 5 MHz signal at U131 Pin 12. U132B together with the input phase shift circuit (L150, C350, C351 and R285) double the 5 MHz signal to 10 MHz at U132B Pin 6. U132C mixes the 10 MHz signal from Pin 6 and the 10.05 MHz signal from Pin 11 to produce the 50 KHz BFO signal at Pin 8. A LPF reduces the undesired higher frequency products and provides a cleaner 50 KHz signal to J106.

$$f_{BFO} = f_{2nd\ LO} - f_{REF} - (2 \times 5\ MHz)$$

VHF REFERENCE

The VHF reference is a 3.5 MHz signal derived from the 35 MHz reference oscillator and sent to the optional VHF converter board via J105. The 35 MHz reference signal is divided by 10 by U130. The 3.5 MHz output at U130 Pin 4 is buffered by Q136. A LPF reduces harmonic content and provides a sinusoidal 3.5 MHz signal to J105.

SYNTHESIZER AND MICROPROCESSOR BOARD PARTS LIST

REF	PART NUM	DESCRIPTION
C100	3151648	CAP AX .10 MF 50V
C101	3151405	CAP AXIAL .001 MF 10% Y5P
C102	3151648	CAP AX .10 MF 50V
C103	3151405	CAP AXIAL .001 MF 10% Y5P
C104	3180241	CAP ELECTRO 470@16
C105	3151259	CAP AXIAL 220 PF 10% Y5P
C106	3150350	CAP AXIAL 10.0 PF 5% NPO
C107	3180109	CAP ELECTRO 22@25 20%
C108	3150305	CAP AXIAL 8.2 PF 10% NPO
C109	3150690	CAP AXIAL 33.0 PF 5% NPO
C110	3151648	CAP AX .10 MF 50V
C111	3150305	CAP AXIAL 8.2 PF 10% NPO
C112	3150595	CAP AXIAL 22.0 PF 5% NPO
C113	3151648	CAP AX .10 MF 50V
C114	3150305	CAP AXIAL 8.2 PF 10% NPO
C115	3150420	CAP AXIAL 12.0 PF 5% NPO
C116	3151648	CAP AX .10 MF 50V
C117	3150305	CAP AXIAL 8.2 PF 10% NPO
C118	3150350	CAP AXIAL 10.0 PF 5% NPO
C119	3151648	CAP AX .10 MF 50V
C120	3180241	CAP ELECTRO 470@16
C121	3150078	CAP AXIAL 3.9 PF 10% NPO
C122	3150690	CAP AXIAL 33.0 PF 5% NPO
C123	3151648	CAP AX .10 MF 50V
C124	3150350	CAP AXIAL 10.0 PF 5% NPO
C125	3150305	CAP AXIAL 8.2 PF 10% NPO
C126	3150640	CAP AXIAL 27.0 PF 5% NPO
C127	3150305	CAP AXIAL 8.2 PF 10% NPO
C128	3150640	CAP AXIAL 27.0 PF 5% NPO
C129	3150350	CAP AXIAL 10.0 PF 5% NPO
C130	3150640	CAP AXIAL 27.0 PF 5% NPO
C131	3150350	CAP AXIAL 10.0 PF 5% NPO
C132	3150640	CAP AXIAL 27.0 PF 5% NPO
C133	3151405	CAP AXIAL .001 MF 10% Y5P
C134	3151648	CAP AX .10 MF 50V
C135	3151648	CAP AX .10 MF 50V
C136	3151405	CAP AXIAL .001 MF 10% Y5P
C137	3150640	CAP AXIAL 27.0 PF 5% NPO
C138	3150899	CAP AXIAL 68.0 PF 5% NPO
C139	3150640	CAP AXIAL 27.0 PF 5% NPO
C140	3151425	CAP AXIAL .0022MF 20% Y5P
C141	3150899	CAP AXIAL 68.0 PF 5% NPO
C142	3150896	CAP AXIAL 56.0 PF 5% NPO
C143	3150750	CAP AXIAL 39.0 PF 5% NPO
C144	3150750	CAP AXIAL 39.0 PF 5% NPO
C145	3151405	CAP AXIAL .001 MF 10% Y5P
C146	3151405	CAP AXIAL .001 MF 10% Y5P
C147	3151405	CAP AXIAL .001 MF 10% Y5P
C148	3151405	CAP AXIAL .001 MF 10% Y5P
C149	3151405	CAP AXIAL .001 MF 10% Y5P
C150	3151405	CAP AXIAL .001 MF 10% Y5P
C151	3151425	CAP AXIAL .0022MF 20% Y5P
C152	3151405	CAP AXIAL .001 MF 10% Y5P
C153	3151405	CAP AXIAL .001 MF 10% Y5P
C154	3151065	CAP AXIAL 100 PF 5% GP
C155	3151515	CAP AXIAL .01 MF 20% Y5P
C156	3151515	CAP AXIAL .01 MF 20% Y5P
C157	3180109	CAP ELECTRO 22@25 20%
C158	3180012	CAP ELECTRO 1@50 20%
C159	3151515	CAP AXIAL .01 MF 20% Y5P
C160	3180012	CAP ELECTRO 1@50 20%
C161	3180012	CAP ELECTRO 1@50 20%
C162	3151515	CAP AXIAL .01 MF 20% Y5P
C163	3184068	CAP FILM .1 @ 100V 10%
C164	3180152	CAP ELECTRO 100@50
C165	3183011	CAP TANT.RAD'L 1.0@35 10%
C166	3180109	CAP ELECTRO 22@25 20%
C167	3151515	CAP AXIAL .01 MF 20% Y5P
C168	3180152	CAP ELECTRO 100@50
C169	3183011	CAP TANT.RAD'L 1.0@35 10%
C170	3184068	CAP FILM .1 @ 100V 10%
C171	3151065	CAP AXIAL 100 PF 5% GP
C172	3151515	CAP AXIAL .01 MF 20% Y5P
C173	3151065	CAP AXIAL 100 PF 5% GP
C174	3150350	CAP AXIAL 10.0 PF 5% NPO
C175	3150779	CAP AXIAL 43.0 PF 5% NPO
C176	3151515	CAP AXIAL .01 MF 20% Y5P
C177	3150040	CAP AXIAL 2.7 PF 10% GP
C178	3150078	CAP AXIAL 3.9 PF 10% NPO
C179	3150115	CAP AXIAL 4.7 PF 10% NPO
C180	3150030	CAP AXIAL 1.5 PF 10% GP
C181	3150040	CAP AXIAL 2.7 PF 10% GP
C182	3150040	CAP AXIAL 2.7 PF 10% GP
C183	3150350	CAP AXIAL 10.0 PF 5% NPO
C184	3151405	CAP AXIAL .001 MF 10% Y5P
C185	3151065	CAP AXIAL 100 PF 5% GP
C186	3151405	CAP AXIAL .001 MF 10% Y5P
C187	3180295	CAP ELECTRO 1000@16 RAD'L
C188	3150030	CAP AXIAL 1.5 PF 10% GP
C189	3150779	CAP AXIAL 43.0 PF 5% NPO
C190	3150030	CAP AXIAL 1.5 PF 10% GP
C191	3150779	CAP AXIAL 43.0 PF 5% NPO
C192	3150350	CAP AXIAL 10.0 PF 5% NPO
C193	3151515	CAP AXIAL .01 MF 20% Y5P
C194	3180012	CAP ELECTRO 1@50 20%
C195	3180109	CAP ELECTRO 22@25 20%
C196	3151515	CAP AXIAL .01 MF 20% Y5P
C197	3151515	CAP AXIAL .01 MF 20% Y5P
C198	3151515	CAP AXIAL .01 MF 20% Y5P
C199	3180012	CAP ELECTRO 1@50 20%
C200	3180012	CAP ELECTRO 1@50 20%
C201	3151515	CAP AXIAL .01 MF 20% Y5P
C202	3180064	CAP ELECTRO 10@50 20%
C203	3180064	CAP ELECTRO 10@50 20%
C204	3180064	CAP ELECTRO 10@50 20%
C205	3180064	CAP ELECTRO 10@50 20%
C206	3151515	CAP AXIAL .01 MF 20% Y5P
C207	3180012	CAP ELECTRO 1@50 20%
C208	3180109	CAP ELECTRO 22@25 20%
C209	3151515	CAP AXIAL .01 MF 20% Y5P
C210	3151515	CAP AXIAL .01 MF 20% Y5P
C211	3151515	CAP AXIAL .01 MF 20% Y5P
C212	3151515	CAP AXIAL .01 MF 20% Y5P
C213	3151515	CAP AXIAL .01 MF 20% Y5P
C214	3180012	CAP ELECTRO 1@50 20%
C215	3180012	CAP ELECTRO 1@50 20%
C216	3150350	CAP AXIAL 10.0 PF 5% NPO
C217	3150750	CAP AXIAL 39.0 PF 5% NPO
C218	3150040	CAP AXIAL 2.7 PF 10% GP

REF	PART NUM	DESCRIPTION
C219	3150595	CAP AXIAL 22.0 PF 5% NPO
C220	3150350	CAP AXIAL 10.0 PF 5% NPO
C221	3150896	CAP AXIAL 56.0 PF 5% NPO
C222	3150595	CAP AXIAL 22.0 PF 5% NPO
C223	3150350	CAP AXIAL 10.0 PF 5% NPO
C224	3151515	CAP AXIAL .01 MF 20% Y5P
C225	3150350	CAP AXIAL 10.0 PF 5% NPO
C226	3180012	CAP ELECTRO 1@50 20%
C227	3151648	CAP AX .10 MF 50V
C228	3151405	CAP AXIAL .001 MF 10% Y5P
C229	3151405	CAP AXIAL .001 MF 10% Y5P
C230	3150595	CAP AXIAL 22.0 PF 5% NPO
C231	3150896	CAP AXIAL 56.0 PF 5% NPO
C232	3180064	CAP ELECTRO 10@50 20%
C233	3150595	CAP AXIAL 22.0 PF 5% NPO
C234	3180012	CAP ELECTRO 1@50 20%
C235	3150750	CAP AXIAL 39.0 PF 5% NPO
C236	3150040	CAP AXIAL 2.7 PF 10% GP
C237	3150690	CAP AXIAL 33.0 PF 5% NPO
C238	3180064	CAP ELECTRO 10@50 20%
C239	3180012	CAP ELECTRO 1@50 20%
C240	3151648	CAP AX .10 MF 50V
C241	3151405	CAP AXIAL .001 MF 10% Y5P
C242	3151405	CAP AXIAL .001 MF 10% Y5P
C243	3180012	CAP ELECTRO 1@50 20%
C244	3151515	CAP AXIAL .01 MF 20% Y5P
C245	3150350	CAP AXIAL 10.0 PF 5% NPO
C246	3150350	CAP AXIAL 10.0 PF 5% NPO
C247	3150115	CAP AXIAL 4.7 PF 10% NPO
C248	3150245	CAP AXIAL 6.8 PF 10% NPO
C249	3150115	CAP AXIAL 4.7 PF 10% NPO
C250	3150350	CAP AXIAL 10.0 PF 5% NPO
C251	3150508	CAP AXIAL 15.0 PF 5% NPO
C252	3180109	CAP ELECTRO 22@25 20%
C253	3150305	CAP AXIAL 8.2 PF 10% NPO
C254	3150115	CAP AXIAL 4.7 PF 10% NPO
C255	3151405	CAP AXIAL .001 MF 10% Y5P
C256	3151648	CAP AX .10 MF 50V
C257	3151405	CAP AXIAL .001 MF 10% Y5P
C258	3150350	CAP AXIAL 10.0 PF 5% NPO
C259	3150305	CAP AXIAL 8.2 PF 10% NPO
C260	3180109	CAP ELECTRO 22@25 20%
C261	3150508	CAP AXIAL 15.0 PF 5% NPO
C262	3150350	CAP AXIAL 10.0 PF 5% NPO
C263	3150115	CAP AXIAL 4.7 PF 10% NPO
C264	3150245	CAP AXIAL 6.8 PF 10% NPO
C265	3150115	CAP AXIAL 4.7 PF 10% NPO
C266	3150350	CAP AXIAL 10.0 PF 5% NPO
C267	3151405	CAP AXIAL .001 MF 10% Y5P
C268	3164032	CAP DISC 33.0 PF 5%
C269	3164160	CAP DISC 330 PF 5%
C270	3150350	CAP AXIAL 10.0 PF 5% NPO
C271	3150779	CAP AXIAL 43.0 PF 5% NPO
C272	3150350	CAP AXIAL 10.0 PF 5% NPO
C273	3151515	CAP AXIAL .01 MF 20% Y5P
C274	3151405	CAP AXIAL .001 MF 10% Y5P
C275	3180109	CAP ELECTRO 22@25 20%
C276	3180109	CAP ELECTRO 22@25 20%
C277	3151515	CAP AXIAL .01 MF 20% Y5P
C278	3151515	CAP AXIAL .01 MF 20% Y5P
C279	3151515	CAP AXIAL .01 MF 20% Y5P
C280	3184068	CAP FILM .1 @ 100V 10%
C281	3184042	CAP FILM .022 @ 100V 5%
C282	3151515	CAP AXIAL .01 MF 20% Y5P
C283	3151648	CAP AX .10 MF 50V
C284	3151515	CAP AXIAL .01 MF 20% Y5P
C285	3184042	CAP FILM .022 @ 100V 5%
C286	3184021	CAP FILM .0047 @ 50V 5%
C287	3151515	CAP AXIAL .01 MF 20% Y5P
C288	3151515	CAP AXIAL .01 MF 20% Y5P
C289	3151515	CAP AXIAL .01 MF 20% Y5P
C290	3180109	CAP ELECTRO 22@25 20%
C291	3180109	CAP ELECTRO 22@25 20%
C292	3151405	CAP AXIAL .001 MF 10% Y5P
C293	3151515	CAP AXIAL .01 MF 20% Y5P
C294	3150420	CAP AXIAL 12.0 PF 5% NPO
C295	3150779	CAP AXIAL 43.0 PF 5% NPO
C296	3150350	CAP AXIAL 10.0 PF 5% NPO
C297	3150350	CAP AXIAL 10.0 PF 5% NPO
C298	3150779	CAP AXIAL 43.0 PF 5% NPO
C299	3150420	CAP AXIAL 12.0 PF 5% NPO
C300	3180012	CAP ELECTRO 1@50 20%
C301	3180109	CAP ELECTRO 22@25 20%
C302	3151515	CAP AXIAL .01 MF 20% Y5P
C303	3151515	CAP AXIAL .01 MF 20% Y5P
C304	3151515	CAP AXIAL .01 MF 20% Y5P
C305	3151515	CAP AXIAL .01 MF 20% Y5P
C306	3151515	CAP AXIAL .01 MF 20% Y5P
C307	3180012	CAP ELECTRO 1@50 20%
C308	3180012	CAP ELECTRO 1@50 20%
C309	3150690	CAP AXIAL 33.0 PF 5% NPO
C310	3150899	CAP AXIAL 68.0 PF 5% NPO
C311	3150690	CAP AXIAL 33.0 PF 5% NPO
C312	3151515	CAP AXIAL .01 MF 20% Y5P
C313	3151515	CAP AXIAL .01 MF 20% Y5P
C314	3151515	CAP AXIAL .01 MF 20% Y5P
C315	3180109	CAP ELECTRO 22@25 20%
C316	3151515	CAP AXIAL .01 MF 20% Y5P
C317	3151515	CAP AXIAL .01 MF 20% Y5P
C318	3151345	CAP AXIAL 470 PF 10% Y5P
C319	3150779	CAP AXIAL 43.0 PF 5% NPO
C320	3151117	CAP AXIAL 120 PF 5% GP
C321	3150779	CAP AXIAL 43.0 PF 5% NPO
C322	3151515	CAP AXIAL .01 MF 20% Y5P
C323	3180012	CAP ELECTRO 1@50 20%
C324	3151515	CAP AXIAL .01 MF 20% Y5P
C325	3151515	CAP AXIAL .01 MF 20% Y5P
C326	3151515	CAP AXIAL .01 MF 20% Y5P
C327	3180012	CAP ELECTRO 1@50 20%
C328	3151515	CAP AXIAL .01 MF 20% Y5P
C329	3180012	CAP ELECTRO 1@50 20%
C330	3180109	CAP ELECTRO 22@25 20%
C331	3151648	CAP AX .10 MF 50V
C332	3151405	CAP AXIAL .001 MF 10% Y5P
C333	3151405	CAP AXIAL .001 MF 10% Y5P
C334	3151405	CAP AXIAL .001 MF 10% Y5P
C335	3151515	CAP AXIAL .01 MF 20% Y5P
C336	3151345	CAP AXIAL 470 PF 10% Y5P
C337	3151418	CAP AXIAL .0015MF 20% Y5P
C338	3151345	CAP AXIAL 470 PF 10% Y5P
C339	3151648	CAP AX .10 MF 50V
C340	3151405	CAP AXIAL .001 MF 10% Y5P
C341	3151648	CAP AX .10 MF 50V

REF	PART NUM	DESCRIPTION
C342	3151405	CAP AXIAL .001 MF 10% Y5P
C343	3151405	CAP AXIAL .001 MF 10% Y5P
C344	3151405	CAP AXIAL .001 MF 10% Y5P
C345	3151648	CAP AX .10 MF 50V
C346	3151405	CAP AXIAL .001 MF 10% Y5P
C347	3180109	CAP ELECTRO 22@25 20%
C348	3151405	CAP AXIAL .001 MF 10% Y5P
C349	3151405	CAP AXIAL .001 MF 10% Y5P
C350	3151345	CAP AXIAL 470 PF 10% Y5P
C351	3150690	CAP AXIAL 33.0 PF 5% NPO
C352	3151405	CAP AXIAL .001 MF 10% Y5P
C353	3150690	CAP AXIAL 33.0 PF 5% NPO
C354	3150750	CAP AXIAL 39.0 PF 5% NPO
C355	3151405	CAP AXIAL .001 MF 10% Y5P
C356	3150420	CAP AXIAL 12.0 PF 5% NPO
C357	3151405	CAP AXIAL .001 MF 10% Y5P
C358	3150420	CAP AXIAL 12.0 PF 5% NPO
C359	3180109	CAP ELECTRO 22@25 20%
C360	3150690	CAP AXIAL 33.0 PF 5% NPO
C361	3151515	CAP AXIAL .01 MF 20% Y5P
C362	3150245	CAP AXIAL 6.8 PF 10% NPO
C363	3151405	CAP AXIAL .001 MF 10% Y5P
C364	3151345	CAP AXIAL 470 PF 10% Y5P
C365	3151515	CAP AXIAL .01 MF 20% Y5P
C366	3151155	CAP AXIAL 150 PF 10% Y5P
C367	3150845	CAP AXIAL 47.0 PF 5% N750
C368	3151515	CAP AXIAL .01 MF 20% Y5P
C369	3180109	CAP ELECTRO 22@25 20%
C370	3151648	CAP AX .10 MF 50V
C371	3151155	CAP AXIAL 150 PF 10% Y5P
C372	3151515	CAP AXIAL .01 MF 20% Y5P
C373	3151648	CAP AX .10 MF 50V
C374	3151515	CAP AXIAL .01 MF 20% Y5P
C375	3151117	CAP AXIAL 120 PF 5% GP
C376	3151648	CAP AX .10 MF 50V
C377	3151405	CAP AXIAL .001 MF 10% Y5P
C378	3180109	CAP ELECTRO 22@25 20%
C379	3150899	CAP AXIAL 68.0 PF 5% NPO
C380	3150750	CAP AXIAL 39.0 PF 5% NPO
C381	3150690	CAP AXIAL 33.0 PF 5% NPO
C382	3150899	CAP AXIAL 68.0 PF 5% NPO
C383	3151648	CAP AX .10 MF 50V
C384	3151515	CAP AXIAL .01 MF 20% Y5P
C385	3180109	CAP ELECTRO 22@25 20%
C386	3180012	CAP ELECTRO 1@50 20%
C387	3180002	CAP ELECTRO .22@50 L.LEAK
C388	3151648	CAP AX .10 MF 50V
C389	3180295	CAP ELECTRO 1000@16 RAD'L
C390	3151648	CAP AX .10 MF 50V
C391	3151648	CAP AX .10 MF 50V
C392	3150690	CAP AXIAL 33.0 PF 5% NPO
C393	3150690	CAP AXIAL 33.0 PF 5% NPO
C394	3151648	CAP AX .10 MF 50V
C395	3151648	CAP AX .10 MF 50V
C396	3151648	CAP AX .10 MF 50V
C397	3151648	CAP AX .10 MF 50V
C398	3151648	CAP AX .10 MF 50V
C399	3151648	CAP AX .10 MF 50V
C400	3151648	CAP AX .10 MF 50V
C401	3151648	CAP AX .10 MF 50V
C402	3205205	CAP VAR TRIM. 3.3-20.5 PF
C403	3150690	CAP AXIAL 33.0 PF 5% NPO
C404	3151648	CAP AX .10 MF 50V
C405	3151648	CAP AX .10 MF 50V
C406	3151648	CAP AX .10 MF 50V
C407	3151648	CAP AX .10 MF 50V
C409	3166105	CAP CHIP .01UF 60V 8MM
C410	3166105	CAP CHIP .01UF 60V 8MM
C411	3166105	CAP CHIP .01UF 60V 8MM
C412	3166105	CAP CHIP .01UF 60V 8MM
C413	3166105	CAP CHIP .01UF 60V 8MM
C414	3166105	CAP CHIP .01UF 60V 8MM
C415	3166105	CAP CHIP .01UF 60V 8MM
C416	3166105	CAP CHIP .01UF 60V 8MM
C417	3151405	CAP AXIAL .001 MF 10% Y5P
C418	3150896	CAP AXIAL 56 pF, 5%, NPO
CR100	3020090	DIODE 1N4148
CR101	3020090	DIODE 1N4148
CR102	3020090	DIODE 1N4148
CR103	3020090	DIODE 1N4148
CR104	3020088	DIODE 1N4099 6.8V 5% .25W
CR105	3020335	DIODE 1S2186
CR106	3020335	DIODE 1S2186
CR107	3020335	DIODE 1S2186
CR108	3020335	DIODE 1S2186
CR109	3024711	VARACTOR ITT310
CR110	3024711	VARACTOR ITT310
CR111	3024711	VARACTOR ITT310
CR112	3024711	VARACTOR ITT310
CR113	3020090	DIODE 1N4148
CR114	3020401	DIODE 1SS97-2-ND4973-7E
CR115	3020401	DIODE 1SS97-2-ND4973-7E
CR116	3020090	DIODE 1N4148
CR117	3020278	DIODE MV209/1SV101
CR118	3024700	VARACTOR 1S2208B
CR119	3024700	VARACTOR 1S2208B
CR120	3024700	VARACTOR 1S2208B
CR121	3024700	VARACTOR 1S2208B
CR122	3020401	DIODE 1SS97-2-ND4973-7E
CR123	3020401	DIODE 1SS97-2-ND4973-7E
CR124	3020401	DIODE 1SS97-2-ND4973-7E
CR125	3020401	DIODE 1SS97-2-ND4973-7E
CR126	3020401	DIODE 1SS97-2-ND4973-7E
CR127	3020220	DIODE 1N4005-PLASTIC
CR128	3020120	DIODE 1N4740A 10V 5% 1W
CR129	3020401	DIODE 1SS97-2-ND4973-7E
CR130	3020156	DIODE 1N5228B 3.9V 5% .5W
CR131	3020110	DIODE 1N4734A 5.6V 5% 1W
CR132	3020110	DIODE 1N4734A 5.6V 5% 1W
CR133	3020110	DIODE 1N4734A 5.6V 5% 1W
J100	3280042	CONN.COAX PC MT. 90 DEG.
J101	3280746	CONN P.C. 8 PIN FEMALE
J102	3280746	CONN P.C. 8 PIN FEMALE
J103	3280746	CONN P.C. 8 PIN FEMALE
J104	3280756	CONN RT ANG DB9
J105	3280042	CONN.COAX PC MT. 90 DEG.
J106	3280042	CONN.COAX PC MT. 90 DEG.
J107	3280042	CONN.COAX PC MT. 90 DEG.
L100	3524165	COIL RADIAL 5.6 UH
L101	3524165	COIL RADIAL 5.6 UH
L102	3524165	COIL RADIAL 5.6 UH
L103	3524165	COIL RADIAL 5.6 UH
L104	3524165	COIL RADIAL 5.6 UH
L105	3524138	COIL RADIAL 0.27 UH
L106	3524215	COIL AXIAL 0.15 UH

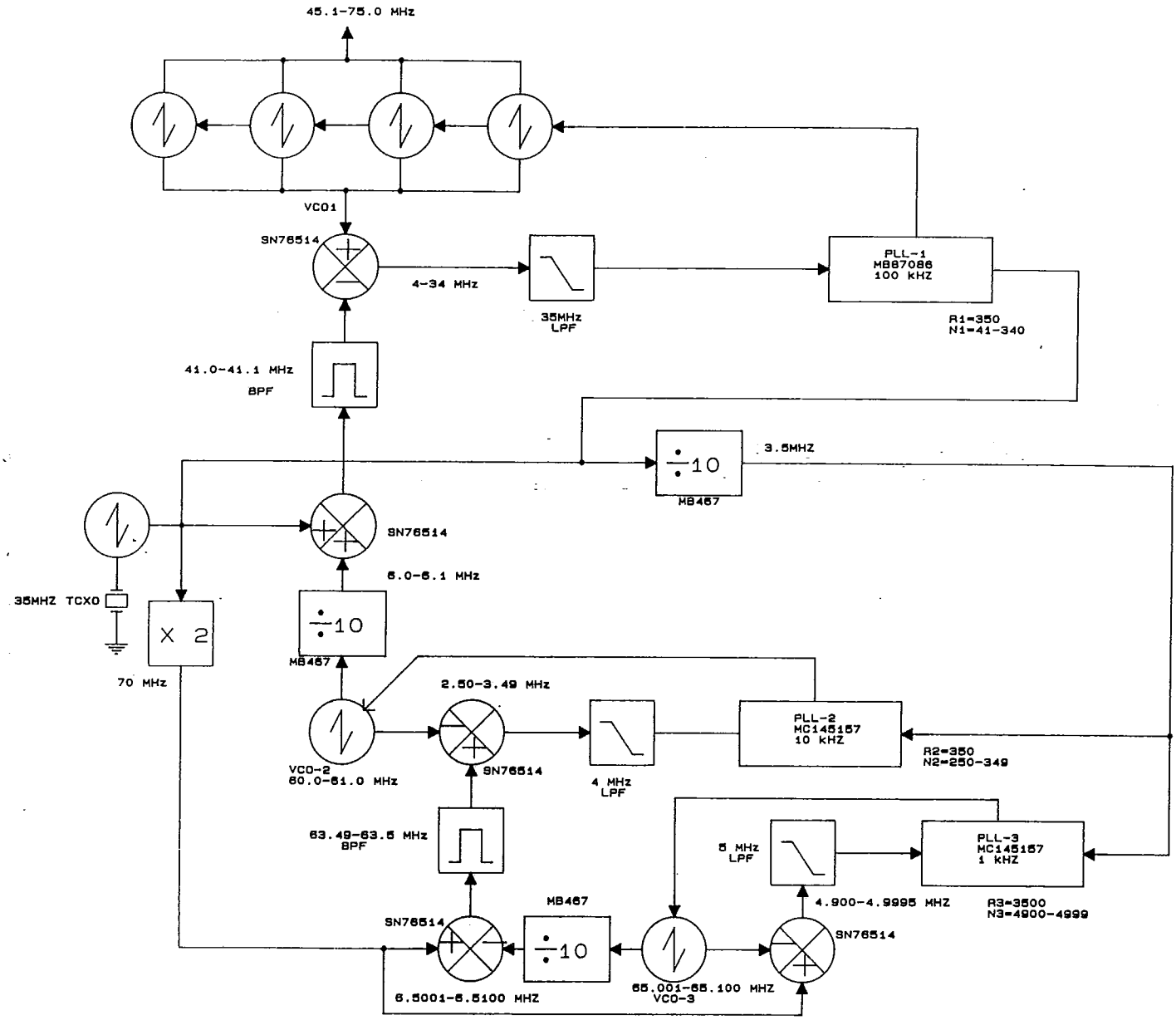
REF	PART NUM	DESCRIPTION
L107	3524215	COIL AXIAL 0.15 UH
L108	3524118	COIL VAR 0.35 UH
L109	3524165	COIL RADIAL 5.6 UH
L110	3524118	COIL VAR 0.35 UH
L111	3524165	COIL RADIAL 5.6 UH
L112	3524116	COIL VAR 0.25 UH
L113	3524165	COIL RADIAL 5.6 UH
L114	3524116	COIL VAR 0.25 UH
L115	3524165	COIL RADIAL 5.6 UH
L116	3524156	COIL RADIAL 2.7 UH
L117	3524155	COIL RADIAL 2.2 UH
L118	3524156	COIL RADIAL 2.7 UH
L119	3524156	COIL RADIAL 2.7 UH
L120	3524104	COIL VAR 7-1/2T 7M VIOLET
L121	3524104	COIL VAR 7-1/2T 7M VIOLET
L122	3524104	COIL VAR 7-1/2T 7M VIOLET
L123	3524111	COIL VAR 0.19 UH
L124	3524176	COIL RADIAL 22.0 UH
L125	3524176	COIL RADIAL 22.0 UH
L126	3524176	COIL RADIAL 22.0 UH
L127	3524176	COIL RADIAL 22.0 UH
L128	3524111	COIL VAR 0.19 UH
L129	3524111	COIL VAR 0.19 UH
L130	3524165	COIL RADIAL 5.6 UH
L131	3524529	COIL VAR. SHLD
L132	3524152	COIL RADIAL 1.8 UH
L133	3524152	COIL RADIAL 1.8 UH
L134	3524117	COIL VAR 0.50 UH
L135	3524117	COIL VAR 0.50 UH
L136	3524152	COIL RADIAL 1.8 UH
L137	3524152	COIL RADIAL 1.8 UH
L138	3524104	COIL VAR 7-1/2T 7M VIOLET (3501055 SHIELD)
L139	3524104	COIL VAR 7-1/2T 7M VIOLET (3501055 SHIELD)
L140	2510078	INDUCTOR TOROID
L141	3524104	COIL VAR 7-1/2T 7M VIOLET (3501055 SHIELD)
L142	3524177	COIL RADIAL 27.0 UH
L143	3524177	COIL RADIAL 27.0 UH
L144	3524181	COIL RADIAL 39.0 UH
L145	3524181	COIL RADIAL 39.0 UH
L146	3524165	COIL RADIAL 5.6 UH
L147	3524160	COIL RADIAL 3.3 UH
L148	3524160	COIL RADIAL 3.3 UH
L149	2510084	INDUCTOR TOROID
L150	3524172	COIL RADIAL 18.0 UH
L151	3524104	COIL VAR 7-1/2T 7M VIOLET (3501055 SHIELD)
L152	3524104	COIL VAR 7-1/2T 7M VIOLET (3501055 SHIELD)
L153	3524138	COIL RADIAL 0.27 UH
L154	3524111	COIL VAR 0.19 UH
L155	3524515	COIL VAR. SHLD
L156	3524156	COIL RADIAL 2.7 UH
L157	3524165	COIL RADIAL 5.6 UH
L158	3524176	COIL RADIAL 22.0 UH
P100	3280720	CONN P.C. 8 PIN MALE
P101	3280724	CONN P.C. 4 PIN MALE
P102	3280718	CONN P.C. 10 PIN MALE
P103	3280718	CONN P.C. 10 PIN MALE
P104	3280719	CONN P.C. 12 PIN MALE
P105	3280723	CONN P.C. 3 PIN MALE
P106	3280723	CONN P.C. 3 PIN MALE
P107	3280723	CONN P.C. 3 PIN MALE
P108	3280723	CONN P.C. 3 PIN MALE
P109	3280726	CONN P.C. 6 PIN MALE
P110	3280723	CONN P.C. 3 PIN MALE
Q100	3030061	TRANSISTOR 2N3563
Q101	3030061	TRANSISTOR 2N3563
Q102	3030104	TRANSISTOR 2N3904
Q103	3030104	TRANSISTOR 2N3904
Q104	3030104	TRANSISTOR 2N3904
Q105	3030104	TRANSISTOR 2N3904
Q106	3030061	TRANSISTOR 2N3563
Q107	3030507	TRANSISTOR 2SK192
Q108	3030507	TRANSISTOR 2SK192
Q109	3030507	TRANSISTOR 2SK192
Q110	3030507	TRANSISTOR 2SK192
Q111	3030061	TRANSISTOR 2N3563
Q112	3030061	TRANSISTOR 2N3563
Q113	3030111	TRANSISTOR 2N4125
Q114	3030104	TRANSISTOR 2N3904
Q115	3030104	TRANSISTOR 2N3904
Q116	3030104	TRANSISTOR 2N3904
Q117	3030111	TRANSISTOR 2N4125
Q118	3030104	TRANSISTOR 2N3904
Q119	3030061	TRANSISTOR 2N3563
Q120	3030061	TRANSISTOR 2N3563
Q121	3030061	TRANSISTOR 2N3563
Q122	3030061	TRANSISTOR 2N3563
Q123	3030061	TRANSISTOR 2N3563
Q124	3030061	TRANSISTOR 2N3563
Q125	3030061	TRANSISTOR 2N3563
Q126	3030061	TRANSISTOR 2N3563
Q127	3030061	TRANSISTOR 2N3563
Q128	3030104	TRANSISTOR 2N3904
Q129	3030104	TRANSISTOR 2N3904
Q130	3030061	TRANSISTOR 2N3563
Q131	3030061	TRANSISTOR 2N3563
Q132	3030104	TRANSISTOR 2N3904
Q133	3030104	TRANSISTOR 2N3904
Q134	3030061	TRANSISTOR 2N3563
Q135	3030061	TRANSISTOR 2N3563
Q136	3030061	TRANSISTOR 2N3563
Q137	3030061	TRANSISTOR 2N3563
Q138	3030061	TRANSISTOR 2N3563
Q139	3030061	TRANSISTOR 2N3563
Q140	3030061	TRANSISTOR 2N3563
Q141	3030061	TRANSISTOR 2N3563
Q142	3030061	TRANSISTOR 2N3563
Q143	3030061	TRANSISTOR 2N3563
Q144	3030104	TRANSISTOR 2N3904
Q145	3030121	TRANSISTOR 2N4402
Q146	3030104	TRANSISTOR 2N3904
Q147	3030104	TRANSISTOR 2N3904
Q148	3030104	TRANSISTOR 2N3904
Q149	3030104	TRANSISTOR 2N3904
Q150	3030104	TRANSISTOR 2N3904
Q151	3030104	TRANSISTOR 2N3904
Q152	3030104	TRANSISTOR 2N3904
Q153	3030104	TRANSISTOR 2N3904
Q154	3030104	TRANSISTOR 2N3904
Q155	3030104	TRANSISTOR 2N3904

REF	PART NUM	DESCRIPTION
R100	3220015	RES C.FILM 22 OHM 5%1/4W
R101	3220245	RES C.FILM 15 K 5% 1/4W
R102	3220085	RES C.FILM 270 OHM 5%1/4W
R103	3220235	RES C.FILM 10 K 5% 1/4W
R104	3220235	RES C.FILM 10 K 5% 1/4W
R105	3220055	RES C.FILM 100 OHM 5%1/4W
R106	3220065	RES C.FILM 150 OHM 5%1/4W
R107	3220035	RES C.FILM 47 OHM 5%1/4W
R108	3220285	RES C.FILM 47 K 5% 1/4W
R109	3220210	RES C.FILM 4.7 K 5% 1/4W
R110	3220285	RES C.FILM 47 K 5% 1/4W
R111	3220210	RES C.FILM 4.7 K 5% 1/4W
R112	3220285	RES C.FILM 47 K 5% 1/4W
R113	3220210	RES C.FILM 4.7 K 5% 1/4W
R114	3220285	RES C.FILM 47 K 5% 1/4W
R115	3220235	RES C.FILM 10 K 5% 1/4W
R116	3220235	RES C.FILM 10 K 5% 1/4W
R117	3220070	RES C.FILM 180 OHM 5%1/4W
R118	3220055	RES C.FILM 100 OHM 5%1/4W
R119	3220055	RES C.FILM 100 OHM 5%1/4W
R120	3220055	RES C.FILM 100 OHM 5%1/4W
R121	3220235	RES C.FILM 10 K 5% 1/4W
R122	3220110	RES C.FILM 470 OHM 5%1/4W
R123	3220110	RES C.FILM 470 OHM 5%1/4W
R124	3220110	RES C.FILM 470 OHM 5%1/4W
R125	3220110	RES C.FILM 470 OHM 5%1/4W
R126	3220055	RES C.FILM 100 OHM 5%1/4W
R127	3220235	RES C.FILM 10 K 5% 1/4W
R128	3220320	RES C.FILM 150 K 5% 1/4W
R129	3220320	RES C.FILM 150 K 5% 1/4W
R130	3220320	RES C.FILM 150 K 5% 1/4W
R131	3220320	RES C.FILM 150 K 5% 1/4W
R132	3220320	RES C.FILM 150 K 5% 1/4W
R133	3220320	RES C.FILM 150 K 5% 1/4W
R134	3220320	RES C.FILM 150 K 5% 1/4W
R135	3220320	RES C.FILM 150 K 5% 1/4W
R136	3220160	RES C.FILM 1.0 K 5% 1/4W
R137	3220060	RES C.FILM 120 OHM 5%1/4W
R138	3220235	RES C.FILM 10 K 5% 1/4W
R139	3220055	RES C.FILM 100 OHM 5%1/4W
R140	3220055	RES C.FILM 100 OHM 5%1/4W
R141	3220235	RES C.FILM 10 K 5% 1/4W
R142	3220160	RES C.FILM 1.0 K 5% 1/4W
R143	3220160	RES C.FILM 1.0 K 5% 1/4W
R144	3220160	RES C.FILM 1.0 K 5% 1/4W
R145	3220160	RES C.FILM 1.0 K 5% 1/4W
R146	3220015	RES C.FILM 22 OHM 5%1/4W
R147	3220115	RES C.FILM 510 OHM 5%1/4W
R148	3220055	RES C.FILM 100 OHM 5%1/4W
R149	3220270	RES C.FILM 27 K 5% 1/4W
R150	3220235	RES C.FILM 10 K 5% 1/4W
R151	3220070	RES C.FILM 180 OHM 5%1/4W
R152	3220085	RES C.FILM 270 OHM 5%1/4W
R153	3220175	RES C.FILM 1.5 K 5% 1/4W
R154	3220190	RES C.FILM 2.2 K 5% 1/4W
R155	3220085	RES C.FILM 270 OHM 5%1/4W
R156	3220100	RES C.FILM 390 OHM 5%1/4W
R157	3220180	RES C.FILM 1.8 K 5% 1/4W
R158	3220110	RES C.FILM 470 OHM 5%1/4W
R159	3220160	RES C.FILM 1.0 K 5% 1/4W
R160	3220160	RES C.FILM 1.0 K 5% 1/4W
R161	3220060	RES C.FILM 120 OHM 5%1/4W
R162	3220125	RES C.FILM 560 OHM 5%1/4W
R163	3220100	RES C.FILM 390 OHM 5%1/4W
R164	3220055	RES C.FILM 100 OHM 5%1/4W
R165	3220190	RES C.FILM 2.2 K 5% 1/4W
R166	3220175	RES C.FILM 1.5 K 5% 1/4W
R167	3220085	RES C.FILM 270 OHM 5%1/4W
R168	3220235	RES C.FILM 10 K 5% 1/4W
R169	3220235	RES C.FILM 10 K 5% 1/4W
R170	3220085	RES C.FILM 270 OHM 5%1/4W
R171	3220005	RES C.FILM 10 OHM 5%1/4W
R172	3220005	RES C.FILM 10 OHM 5%1/4W
R173	3220085	RES C.FILM 270 OHM 5%1/4W
R174	3220070	RES C.FILM 180 OHM 5%1/4W
R175	3220055	RES C.FILM 100 OHM 5%1/4W
R176	3220070	RES C.FILM 180 OHM 5%1/4W
R177	3220215	RES C.FILM 5.6 K 5% 1/4W
R178	3220145	RES C.FILM 820 OHM 5%1/4W
R179	3220160	RES C.FILM 1.0 K 5% 1/4W
R180	3220060	RES C.FILM 120 OHM 5%1/4W
R181	3220195	RES C.FILM 2.7 K 5% 1/4W
R182	3220235	RES C.FILM 10 K 5% 1/4W
R183	3220140	RES C.FILM 680 OHM 5%1/4W
R184	3220055	RES C.FILM 100 OHM 5%1/4W
R185	3220055	RES C.FILM 100 OHM 5%1/4W
R186	3220045	RES C.FILM 68 OHM 5%1/4W
R187	3220055	RES C.FILM 100 OHM 5%1/4W
R188	3220055	RES C.FILM 100 OHM 5%1/4W
R189	3220315	RES C.FILM 100 K 5% 1/4W
R190	3220110	RES C.FILM 470 OHM 5%1/4W
R191	3220180	RES C.FILM 1.8 K 5% 1/4W
R192	3220180	RES C.FILM 1.8 K 5% 1/4W
R193	3220110	RES C.FILM 470 OHM 5%1/4W
R194	3220055	RES C.FILM 100 OHM 5%1/4W
R195	3220315	RES C.FILM 100 K 5% 1/4W
R196	3220055	RES C.FILM 100 OHM 5%1/4W
R197	3220235	RES C.FILM 10 K 5% 1/4W
R198	3220230	RES C.FILM 8.2 K 5% 1/4W
R199	3220300	RES C.FILM 68 K 5% 1/4W
R200	3220285	RES C.FILM 47 K 5% 1/4W
R201	3220315	RES C.FILM 100 K 5% 1/4W
R202	3220110	RES C.FILM 470 OHM 5%1/4W
R203	3220110	RES C.FILM 470 OHM 5%1/4W
R204	3220130	RES C.FILM 620 OHM 5%1/4W
R205	3220110	RES C.FILM 470 OHM 5%1/4W
R206	3220240	RES C.FILM 12 K 5% 1/4W
R207	3220235	RES C.FILM 10 K 5% 1/4W
R208	3220315	RES C.FILM 100 K 5% 1/4W
R209	3220260	RES C.FILM 22 K 5% 1/4W
R210	3220260	RES C.FILM 22 K 5% 1/4W
R211	3220315	RES C.FILM 100 K 5% 1/4W
R212	3220235	RES C.FILM 10 K 5% 1/4W
R213	3220240	RES C.FILM 12 K 5% 1/4W
R214	3220110	RES C.FILM 470 OHM 5%1/4W
R215	3220130	RES C.FILM 620 OHM 5%1/4W
R216	3220215	RES C.FILM 5.6 K 5% 1/4W
R217	3220085	RES C.FILM 270 OHM 5%1/4W
R218	3220245	RES C.FILM 15 K 5% 1/4W
R219	3220055	RES C.FILM 100 OHM 5%1/4W
R220	3220055	RES C.FILM 100 OHM 5%1/4W
R221	3220315	RES C.FILM 100 K 5% 1/4W
R222	3220110	RES C.FILM 470 OHM 5%1/4W
R223	3220055	RES C.FILM 100 OHM 5%1/4W

REF	PART NUM	DESCRIPTION
R224	3220055	RES C.FILM 100 OHM 5%1/4W
R225	3220235	RES C.FILM 10 K 5% 1/4W
R226	3220205	RES C.FILM 3.9 K 5% 1/4W
R227	3220140	RES C.FILM 680 OHM 5%1/4W
R228	3220275	RES C.FILM 33 K 5% 1/4W
R229	3220220	RES C.FILM 6.8 K 5% 1/4W
R230	3220235	RES C.FILM 10 K 5% 1/4W
R231	3220245	RES C.FILM 15 K 5% 1/4W
R232	3220140	RES C.FILM 680 OHM 5%1/4W
R233	3220205	RES C.FILM 3.9 K 5% 1/4W
R234	3220235	RES C.FILM 10 K 5% 1/4W
R235	3220055	RES C.FILM 100 OHM 5%1/4W
R236	3220055	RES C.FILM 100 OHM 5%1/4W
R237	3220110	RES C.FILM 470 OHM 5%1/4W
R238	3220315	RES C.FILM 100 K 5% 1/4W
R239	3220055	RES C.FILM 100 OHM 5%1/4W
R240	3220055	RES C.FILM 100 OHM 5%1/4W
R241	3220055	RES C.FILM 100 OHM 5%1/4W
R242	3220235	RES C.FILM 10 K 5% 1/4W
R243	3220055	RES C.FILM 100 OHM 5%1/4W
R244	3220055	RES C.FILM 100 OHM 5%1/4W
R245	3220210	RES C.FILM 4.7 K 5% 1/4W
R246	3220260	RES C.FILM 22 K 5% 1/4W
R247	3220075	RES C.FILM 220 OHM 5%1/4W
R248	3220145	RES C.FILM 820 OHM 5%1/4W
R249	3220110	RES C.FILM 470 OHM 5%1/4W
R250	3220235	RES C.FILM 10 K 5% 1/4W
R251	3220145	RES C.FILM 820 OHM 5%1/4W
R252	3220055	RES C.FILM 100 OHM 5%1/4W
R253	3220210	RES C.FILM 4.7 K 5% 1/4W
R254	3220055	RES C.FILM 100 OHM 5%1/4W
R255	3220190	RES C.FILM 2.2 K 5% 1/4W
R256	3220230	RES C.FILM 8.2 K 5% 1/4W
R257	3220005	RES C.FILM 10 OHM 5%1/4W
R258	3220025	RES C.FILM 33 OHM 5%1/4W
R259	3220002	RES C.FILM 3.3 OHM 5%1/4W
R260	3220002	RES C.FILM 3.3 OHM 5%1/4W
R261	3220025	RES C.FILM 33 OHM 5%1/4W
R262	3220005	RES C.FILM 10 OHM 5%1/4W
R263	3220230	RES C.FILM 8.2 K 5% 1/4W
R264	3220190	RES C.FILM 2.2 K 5% 1/4W
R265	3220045	RES C.FILM 68 OHM 5%1/4W
R266	3220015	RES C.FILM 22 OHM 5%1/4W
R267	3220045	RES C.FILM 68 OHM 5%1/4W
R268	0000000	NO PART
R269	3220055	RES C.FILM 100 OHM 5%1/4W
R270	3220235	RES C.FILM 10 K 5% 1/4W
R271	3220215	RES C.FILM 5.6 K 5% 1/4W
R272	3220180	RES C.FILM 1.8 K 5% 1/4W
R273	3220035	RES C.FILM 47 OHM 5%1/4W
R274	3220085	RES C.FILM 270 OHM 5%1/4W
R275	3220055	RES C.FILM 100 OHM 5%1/4W
R276	3220220	RES C.FILM 6.8 K 5% 1/4W
R277	3220235	RES C.FILM 10 K 5% 1/4W
R278	3220075	RES C.FILM 220 OHM 5%1/4W
R279	3220235	RES C.FILM 10 K 5% 1/4W
R281	3220190	RES C.FILM 2.2 K 5% 1/4W
R282	3220220	RES C.FILM 6.8 K 5% 1/4W
R283	3220235	RES C.FILM 10 K 5% 1/4W
R284	3220055	RES C.FILM 100 OHM 5%1/4W
R285	3220195	RES C.FILM 2.7 K 5% 1/4W
R286	3220160	RES C.FILM 1.0 K 5% 1/4W
R287	3220075	RES C.FILM 220 OHM 5%1/4W
R288	3220015	RES C.FILM 22 OHM 5%1/4W
R289	3220055	RES C.FILM 100 OHM 5%1/4W
R290	3220015	RES C.FILM 22 OHM 5%1/4W
R291	3220160	RES C.FILM 1.0 K 5% 1/4W
R292	3220190	RES C.FILM 2.2 K 5% 1/4W
R293	3220230	RES C.FILM 8.2 K 5% 1/4W
R294	3220055	RES C.FILM 100 OHM 5%1/4W
R295	3220235	RES C.FILM 10 K 5% 1/4W
R296	3220190	RES C.FILM 2.2 K 5% 1/4W
R297	3220055	RES C.FILM 100 OHM 5%1/4W
R298	3220055	RES C.FILM 100 OHM 5%1/4W
R299	3220235	RES C.FILM 10 K 5% 1/4W
R300	3220005	RES C.FILM 10 OHM 5%1/4W
R301	3220055	RES C.FILM 100 OHM 5%1/4W
R302	3220085	RES C.FILM 270 OHM 5%1/4W
R303	3220210	RES C.FILM 4.7 K 5% 1/4W
R304	3220075	RES C.FILM 220 OHM 5%1/4W
R305	3220210	RES C.FILM 4.7 K 5% 1/4W
R306	3220075	RES C.FILM 220 OHM 5%1/4W
R307	3220115	RES C.FILM 510 OHM 5%1/4W
R308	3220075	RES C.FILM 220 OHM 5%1/4W
R309	3220210	RES C.FILM 4.7 K 5% 1/4W
R310	3220210	RES C.FILM 4.7 K 5% 1/4W
R311	3220315	RES C.FILM 100 K 5% 1/4W
R312	3220315	RES C.FILM 100 K 5% 1/4W
R313	3220210	RES C.FILM 4.7 K 5% 1/4W
R314	3220055	RES C.FILM 100 OHM 5%1/4W
R315	3220235	RES C.FILM 10 K 5% 1/4W
R316	3220315	RES C.FILM 100 K 5% 1/4W
R317	3220315	RES C.FILM 100 K 5% 1/4W
R318	3220235	RES C.FILM 10 K 5% 1/4W
R319	3220285	RES C.FILM 47 K 5% 1/4W
R320	3220260	RES C.FILM 22 K 5% 1/4W
R321	3220160	RES C.FILM 1.0 K 5% 1/4W
R322	3220110	RES C.FILM 470 OHM 5%1/4W
R323	3220190	RES C.FILM 2.2 K 5% 1/4W
R324	3220285	RES C.FILM 47 K 5% 1/4W
R325	3220315	RES C.FILM 100 K 5% 1/4W
R326	3220285	RES C.FILM 47 K 5% 1/4W
R327	3220210	RES C.FILM 4.7 K 5% 1/4W
R328	3220285	RES C.FILM 47 K 5% 1/4W
R329	3220315	RES C.FILM 100 K 5% 1/4W
R330	3220255	RES C.FILM 18 K 5% 1/4W
R331	3220200	RES C.FILM 3.3 K 5% 1/4W
R332	3220330	RES C.FILM 220 K 5% 1/4W
R333	3220210	RES C.FILM 4.7 K 5% 1/4W
R334	3220110	RES C.FILM 470 OHM 5%1/4W
R335	3220100	RES C.FILM 390 OHM 5%1/4W
R336	3250468	RES M.FILM 40.2K 1% 1/4 W
R337	3250463	RES M.FILM 20.0K 1% 1/4 W
R338	3250496	RES M.FILM 324 K 1% 1/4 W
R339	3250491	RES M.FILM 162 K 1% 1/4 W
R340	3250486	RES M.FILM 80.6K 1% 1/4 W
R341	3220235	RES C.FILM 10 K 5% 1/4W
R342	3220160	RES C.FILM 1.0 K 5% 1/4W
R343	3220190	RES C.FILM 2.2 K 5% 1/4W
R344	3220190	RES C.FILM 2.2 K 5% 1/4W
R345	3250425	RES M.FILM 10.0K 1% 1/4 W
R346	3250361	RES M.FILM.4.99K 1% 1/4 W
R347	3250325	RES M.FILM 2.49K 1% 1/4 W

REF	PART NUM	DESCRIPTION
R348	3260664	RES VAR PT10V 10K
R349	3220275	RES C.FILM 33 K 5% 1/4W
R350	3220315	RES C.FILM 100 K 5% 1/4W
R351	3220235	RES C.FILM 10 K 5% 1/4W
R352	3220335	RES C.FILM 270 K 5% 1/4W
R353	3220285	RES C.FILM 47 K 5% 1/4W
R354	3220285	RES C.FILM 47 K 5% 1/4W
R355	3220315	RES C.FILM 100 K 5% 1/4W
R356	3260664	RES VAR PT10V 10K
R357	3220235	RES C.FILM 10 K 5% 1/4W
R358	3220235	RES C.FILM 10 K 5% 1/4W
R359	3220260	RES C.FILM 22 K 5% 1/4W
R360	3220320	RES C.FILM 150 K 5% 1/4W
R361	3220235	RES C.FILM 10 K 5% 1/4W
R362	3220285	RES C.FILM 47 K 5% 1/4W
R363	3220235	RES C.FILM 10 K 5% 1/4W
R364	3220110	RES C.FILM 470 OHM 5%1/4W
R365	3220110	RES C.FILM 470 OHM 5%1/4W
R366	3220210	RES C.FILM 4.7 K 5% 1/4W
R367	3220210	RES C.FILM 4.7 K 5% 1/4W
R368	3220210	RES C.FILM 4.7 K 5% 1/4W
R369	3220210	RES C.FILM 4.7 K 5% 1/4W
R370	3220210	RES C.FILM 4.7 K 5% 1/4W
R371	3220315	RES C.FILM 100 K 5% 1/4W
R372	3220315	RES C.FILM 100 K 5% 1/4W
R373	3220245	RES C.FILM 15 K 5% 1/4W
R374	3220315	RES C.FILM 100 K 5% 1/4W
R375	3220275	RES C.FILM 33 K 5% 1/4W
R376	3220285	RES C.FILM 47 K 5% 1/4W
R377	3220235	RES C.FILM 10 K 5% 1/4W
R378	3220315	RES C.FILM 100 K 5% 1/4W
R379	3220235	RES C.FILM 10 K 5% 1/4W
R380	3220285	RES C.FILM 47 K 5% 1/4W
R381	3220230	RES C.FILM 8.2 K 5% 1/4W
R382	3220210	RES C.FILM 4.7 K 5% 1/4W
R383	3220215	RES C.FILM 5.6 K 5% 1/4W
R384	3220235	RES C.FILM 10 K 5% 1/4W
R385	3220235	RES C.FILM 10 K 5% 1/4W
R386	3220260	RES C.FILM 22 K 5% 1/4W
R387	3220320	RES C.FILM 150 K 5% 1/4W
R388	3220235	RES C.FILM 10 K 5% 1/4W
R389	3220235	RES C.FILM 10 K 5% 1/4W
R390	3220235	RES C.FILM 10 K 5% 1/4W
R391	3220160	RES C.FILM 1.0 K 5% 1/4W
R392	3220315	RES C.FILM 100 K 5% 1/4W
R393	3220315	RES C.FILM 100 K 5% 1/4W
R394	3220315	RES C.FILM 100 K 5% 1/4W
R395	3220315	RES C.FILM 100 K 5% 1/4W
R396	3220110	RES C.FILM 470 OHM 5%1/4W
R397	3220315	RES C.FILM 100 K 5% 1/4W
R398	3220315	RES C.FILM 100 K 5% 1/4W
R399	3220345	RES C.FILM 470 K 5% 1/4W
R400	3220345	RES C.FILM 470 K 5% 1/4W
R401	3220345	RES C.FILM 470 K 5% 1/4W
R402	3220345	RES C.FILM 470 K 5% 1/4W
R403	3220345	RES C.FILM 470 K 5% 1/4W
R404	3220345	RES C.FILM 470 K 5% 1/4W
R405	3220075	RES C.FILM 220 OHM 5%1/4W
R406	3220075	RES C.FILM 220 OHM 5%1/4W
R408	3220075	RES C.FILM 220 OHM 5%1/4W

REF	PART NUM	DESCRIPTION
RP100	3221220	RES PACK 11X10K 12-PIN SIP
RP101	3221220	RES PACK 11X10K 12-PIN SIP
RP102	3221220	RES PACK 11X10K 12-PIN SIP
RP103	3221220	RES PACK 11X10K 12-PIN SIP
RP104	3221220	RES PACK 11X10K 12-PIN SIP
U100	3040011	I.C. 74HC74
U101	3040247	I.C. RE5VA45AX
U102	3040120	I.C. 3302P
U103	3042130	I.C. MM5450
U104	3042004	I.C. 8049
U105	3040009	I.C. 74HC573
U106	4671318	I.C. 27256 EPROM W/R8 VERSION
	3282128	12 SOFTWARE (SOCKET 28 PIN)
U107	3040007	I.C. 74HC174
U108	3042026	I.C. TC8521AP
U109	3041166	I.C. MB87086 PLL
U110	3040094	I.C. LM358
U111	3040003	I.C. 74HC139
U112	3040007	I.C. 74HC174
U113	3040005	I.C. 74HC244
U114	3040006	I.C. 74HC273
U115	3041042	I.C. KM28C16
U116	3040480	I.C. 76514N/TL-442CN
U117	3040480	I.C. 76514N/TL-442CN
U118	3041168	I.C. 145407 P
U119	3040157	I.C. TCF-6000
U120	3040157	I.C. TCF-6000
U121	3040480	I.C. 76514N/TL-442CN
U122	3045007	I.C. MB467 1/10
U123	3045007	I.C. MB467 1/10
U124	3040097	I.C. LF353N
U125	3041167	I.C. 145157 PLL
U126	3041167	I.C. 145157 PLL
U127	3040097	I.C. LF353N
U128	3040480	I.C. 76514N/TL-442CN
U129	3040480	I.C. 76514N/TL-442CN
U130	3045007	I.C. MB467 1/10
U131	3041064	I.C. 74F163
U132	3041063	I.C. 74F86
VR100	3040031	I.C. 78LO5-ACP
VR101	3040031	I.C. 78LO5-ACP
VR102	3040031	I.C. 78LO5-ACP
W1A	2715645	COAX 178 7.75 3/16X1/8X3/16
W2A	2715643	COAX 178 6.0 3/16X1/8X3/16
Y100	3120003	RESONATOR CRYSTAL 6.0 MHZ
Y101	3120285	CRYSTAL 32.768 KHZ
Y102	3120288	CRYSTAL 22.525 MHZ
Y103	3120292	CRYSTAL 35.00 MHZ



$$VCO_3 = f_{STD}\left[2 - \frac{N_3}{3.6E4}\right]$$

$$VCO_2 = f_{STD}\left[1.8 + \frac{N_3}{3.6E6} - \frac{N_2}{3.6E3}\right]$$

$$VCO_1 = f_{STD}\left[1.18 + \frac{N_3}{3.6E6} - \frac{N_2}{3.6E4} + \frac{N_1}{360}\right]$$

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PLL3

VCO3
65.0-65.1MHz

PLL2
63.49-53.50MHz
100mV PTP
4.75VDC

VCO2
60-61MHz

PLL1
45.1-75.0MHz
700mV PTP

VCO1

REFERENCE OSCILLATOR

BFO/DIGITAL MIXER

2ND LO/PBT

FROM MICROPROCESSOR SCHEMATIC D-8213

SYNTH 1
SYNTH 2
SYNTH 3
DATA
CLK
VCO 1
VCO 2
VCO 3
BFO ON
PBT
FM ENA

TO LOOP 1 6.0-6.1MHz

TO LOOP 2 MIXER

TO LOOP 3 MIXER

VHF REF J105

1ST LO TO FRONT END BD J100

45.05MHz 2V PTP

50KHZ OUT TO IF/PS BD J106

45.05MHZ OUT 2ND LO TO FRONT END BD J107

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Synthesizer/Microprocessor Board Schematic D-8137

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Note: This drawing applies to R8/R8E units with Revision "C" printed on circuit board artwork.

PLL3

PLL1

PLL2

VCO3

VCO2

VCO1

REFERENCE OSCILLATOR

BFO/DIGITAL MIXER

2ND LO/PBT

FROM MICROPROCESSOR SCHEMATIC D-8213

SYNTH 1
SYNTH 2
SYNTH 3
S DATA
S CLK

VCO 1
VCO 2
VCO 3
BFO ON
PBT
FR ENA

50KHZ OUT TO IF/PS BD

45.1-75.0MHz 2V PTP 1ST LO TO FRONT END BD

45.05MHz 1.0V PTP 2ND LO TO FRONT END BD

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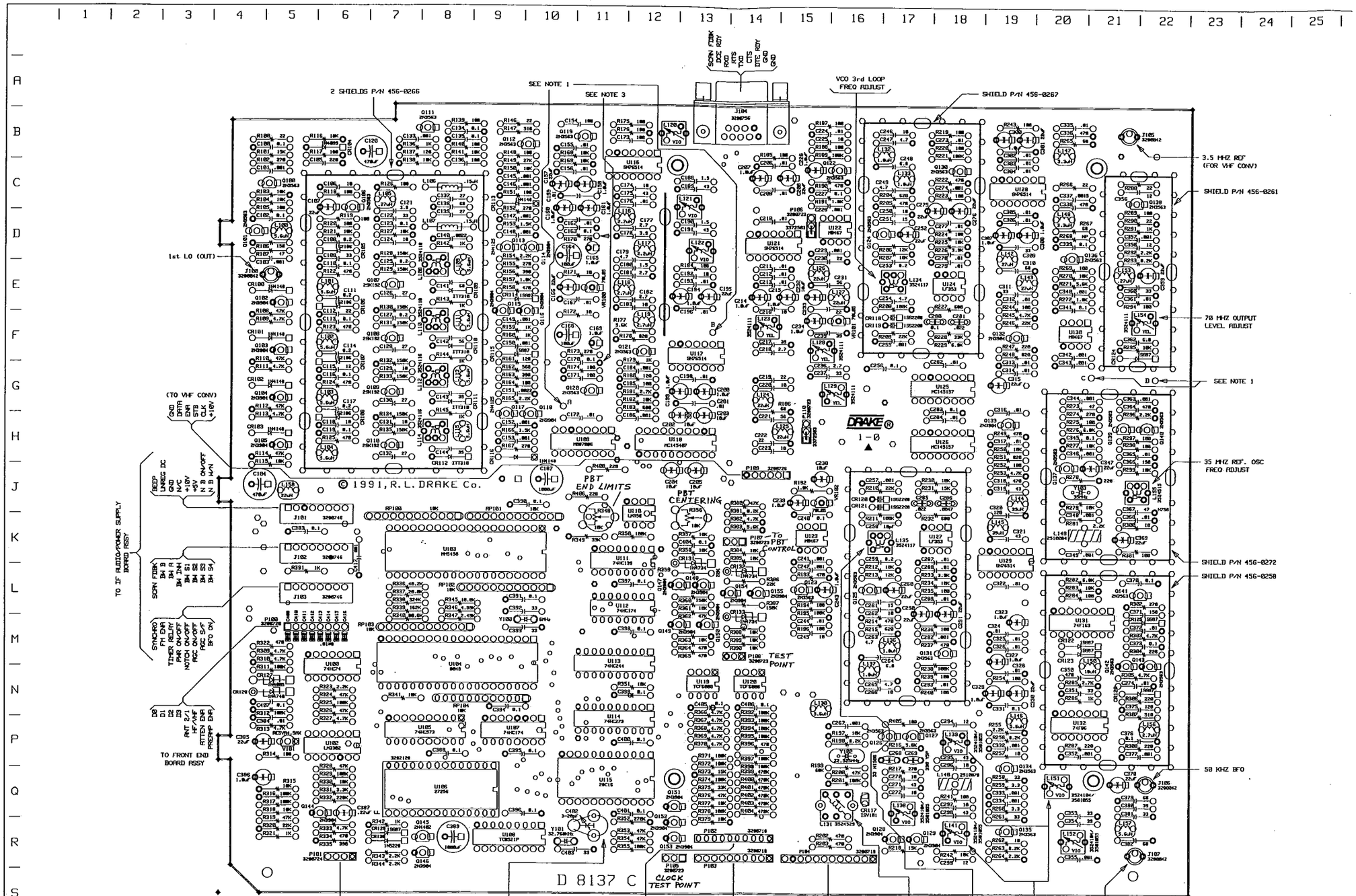

NOTES:

1-ON COMP SIDE, SOLDER COAX P/N 271-5645 BETWEEN POINTS A AND D. SOLDER COAX P/N 271-5643 BETWEEN POINTS B AND C. SOLDER SHIELDS OF COAX TO GND AT EACH TERMINATION POINT.
2-SOLDER METAL SHIELDS TO COMP GND PLANE ALONG ENTIRE SEAM.
3-C163 AND C178 ARE .1uF FILM P/N 318-4068

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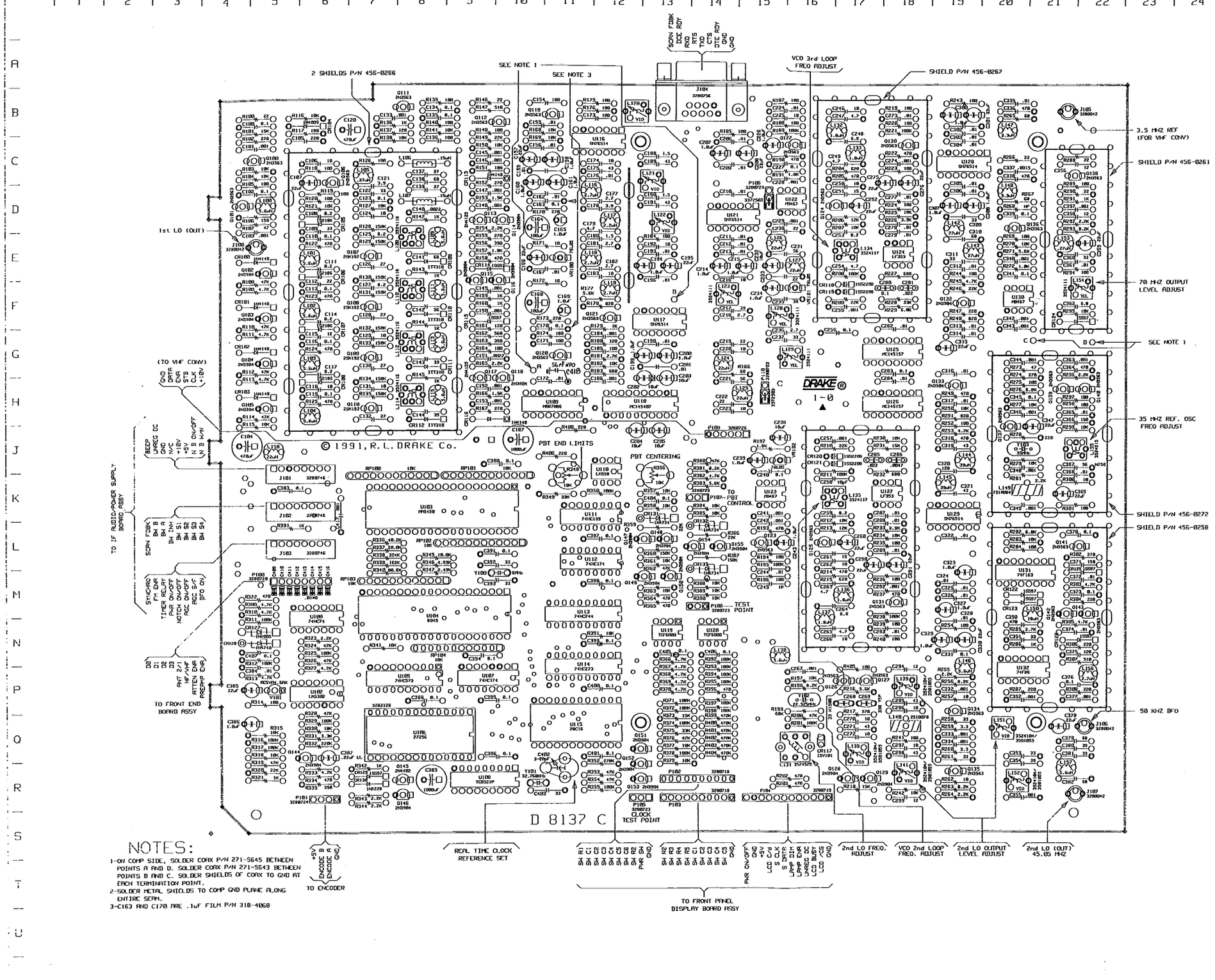
Synthesizer/Microprocessor Board Pictorial D-8137

Note: This drawing applies to R8/R8E units with Revision "C" printed on circuit board artwork.



NOTES:

1-ON COMP SIDE, SOLDER COAX P/N 271-5645 BETWEEN POINTS A AND D. SOLDER COAX P/N 271-5643 BETWEEN POINTS B AND C. SOLDER SHIELDS OF COAX TO GND AT EACH TERMINATION POINT.
2-SOLDER METAL SHIELDS TO COMP GND PLANE ALONG ENTIRE SEAM.
3-C163 AND C170 ARE .1uF FILM P/N 318-4068

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DIGITAL SECTION - THEORY OF OPERATION

1. Microprocessor and Memory
2. Radio Controls
3. Front and Rear Panel I/O Theory of Operation

1. Microprocessor and Memory

The R8/R8E is controlled by an 8049 microcontroller, U104, executing software stored in a 27256 32k EPROM, U106. The address range of the controller is expanded by using two lines from U107 as the high address lines. The System is driven by a 6 MHz oscillator, giving an execution speed of 400 KHz. Nonvolatile memory is in the EEPROM, U115, which retains memory channels, current radio settings, etc. even with loss of power. A real time clock chip, U108, provides the time for the clock and timer functions. It will continue to keep time for approximately 20 minutes with loss of power due to holding capacitor C389 which provides supply voltage to the chip for that long. U111 provides address decoding for the entire system.

At power on, the entire system is reset by the /RESET line being held low momentarily. This is generated by comparators U102C and U102D. The length of the reset pulse is set primarily by the time constant of R332 and C387 discharging through the output of U102C. At power down, this circuitry also generates a low voltage reset signal, triggered by U101. The reset signal is preceded by an interrupt signal from Q144, which allows the controller to save the present radio settings to U115 and do other housekeeping functions to allow an orderly power up when power is restored.

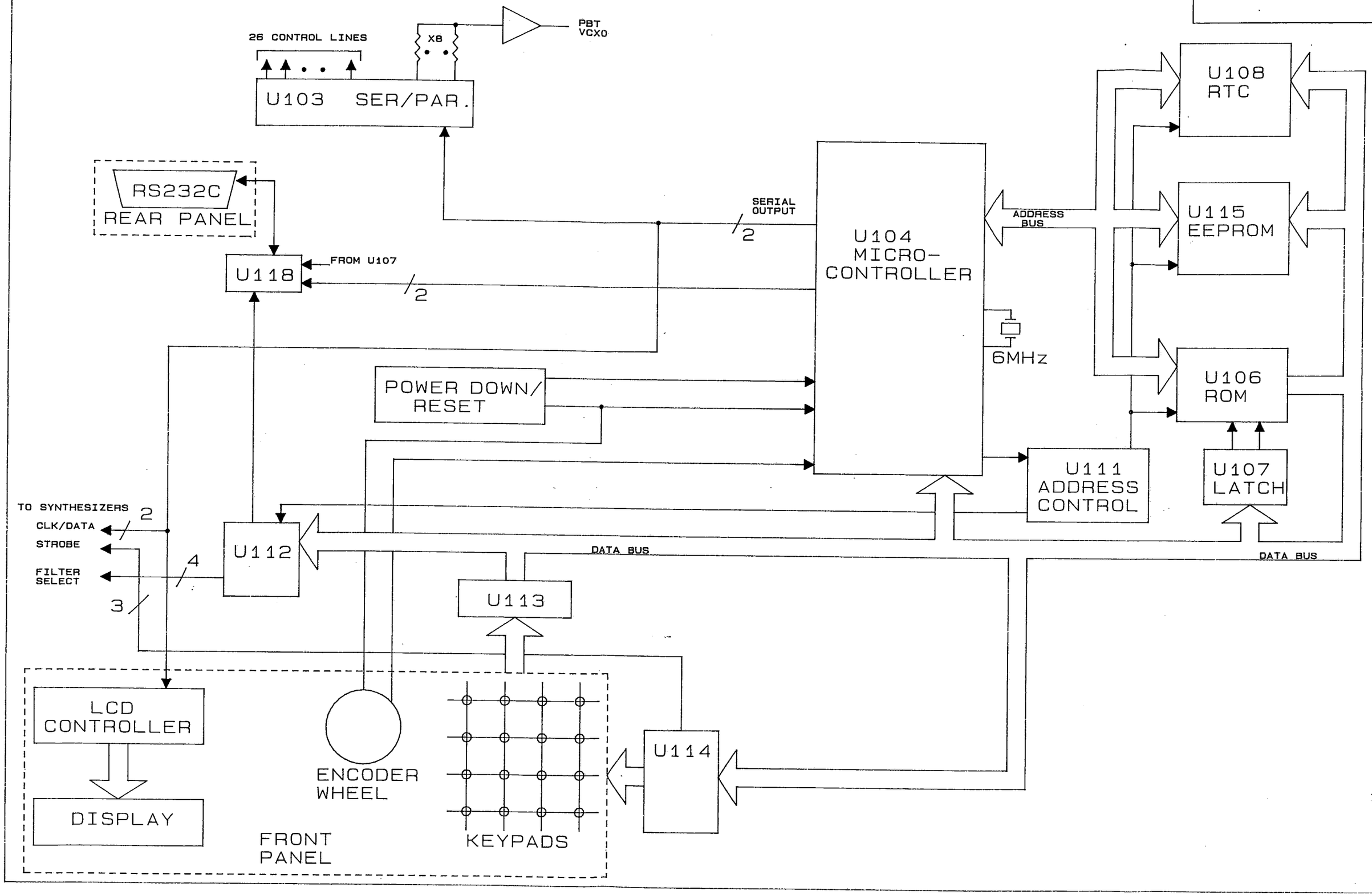
Software execution is such that all functions are performed once every 25 msec. The sequence includes reading the keypad/wheel inputs, setting the radio control lines, setting all frequency synthesizers, and updating the display.

2. Radio Controls

The three frequency synthesizers are all serviced via the same serial port at U104, pins 37 and 38. Data is latched into the appropriate synthesizer to update their information every 25 msec. The remaining radio controls are provided by U103, a 34 bit serial-to-parallel converter. Each output is open-drain with current sink limiting set by R391.

The last 8 output bits of U103 drive a digital-to-analog converter. The outputs are weighted and summed to provide the reference voltage for the pass band filter tuning. This voltage is factory calibrated for each mode of operation (am, fm, etc.) and stored in the EEPROM, U115. Front panel adjustment around the reference voltage is added at U110a.

If the VHF converter option is installed it will be detected by the presence of 5 VDC at P109, pin 4. If the radio is set to a frequency in this band, the converter will be serviced in the normal operating loop of the software. Serial data will be sent to the converter using the serial clock and data lines from U104. These lines are gated to the converter by using U104 pin 29 to switch the pull-up voltage to the buffers driving P109 pins 2 and 5.


26 CONTROL LINES
X8
PBT VCXO
U103 SER/PAR.
RS232C REAR PANEL
U118
FROM U107
SERIAL OUTPUT
2
2
U104 MICRO-CONTROLLER
ADDRESS BUS
U108 RTC
U115 EEPROM
U106 ROM
6MHz
POWER DOWN/ RESET
U111 ADDRESS CONTROL
U107 LATCH
TO SYNTHESIZERS
2
CLK/DATA
STROBE
FILTER SELECT
4
3
U112
DATA BUS
DATA BUS
U113
LCD CONTROLLER
DISPLAY
ENCODER WHEEL
KEYPADS
U114
FRONT PANEL

REAL TIME CLOCK

POWER FAIL DETECTOR

uP/LATCH/MEMORY

NONVOLATILE MEMORY

INTERFACE

VHF INTERFACE

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3. Front & Rear Panel I/O Theory of Operation

The two front panel keypads are both part of one key matrix which is scanned by the controller every 25 msec. Rows are scanned using U114 and column outputs are read from U113. Each key generates a unique row/column combination which is then read and acted on by the controller software. The power on/off key is not part of the scanned matrix and is read every 25 msec. All keys are debounced in software.

The encoder wheel interface provides two output waveforms which are square waves 90 degrees out of phase. When the wheel is turned, the encoder B line clocks a high into the output of U100B, which causes an interrupt via U104 pin 6. When the controller services the interrupt, the high is cleared by a momentary low to U100B pin 13. After clearing the high, the controller looks at the other encoder line on its T1 input (pin 39) to determine which direction the wheel is being turned. The frequency can then be updated accordingly.

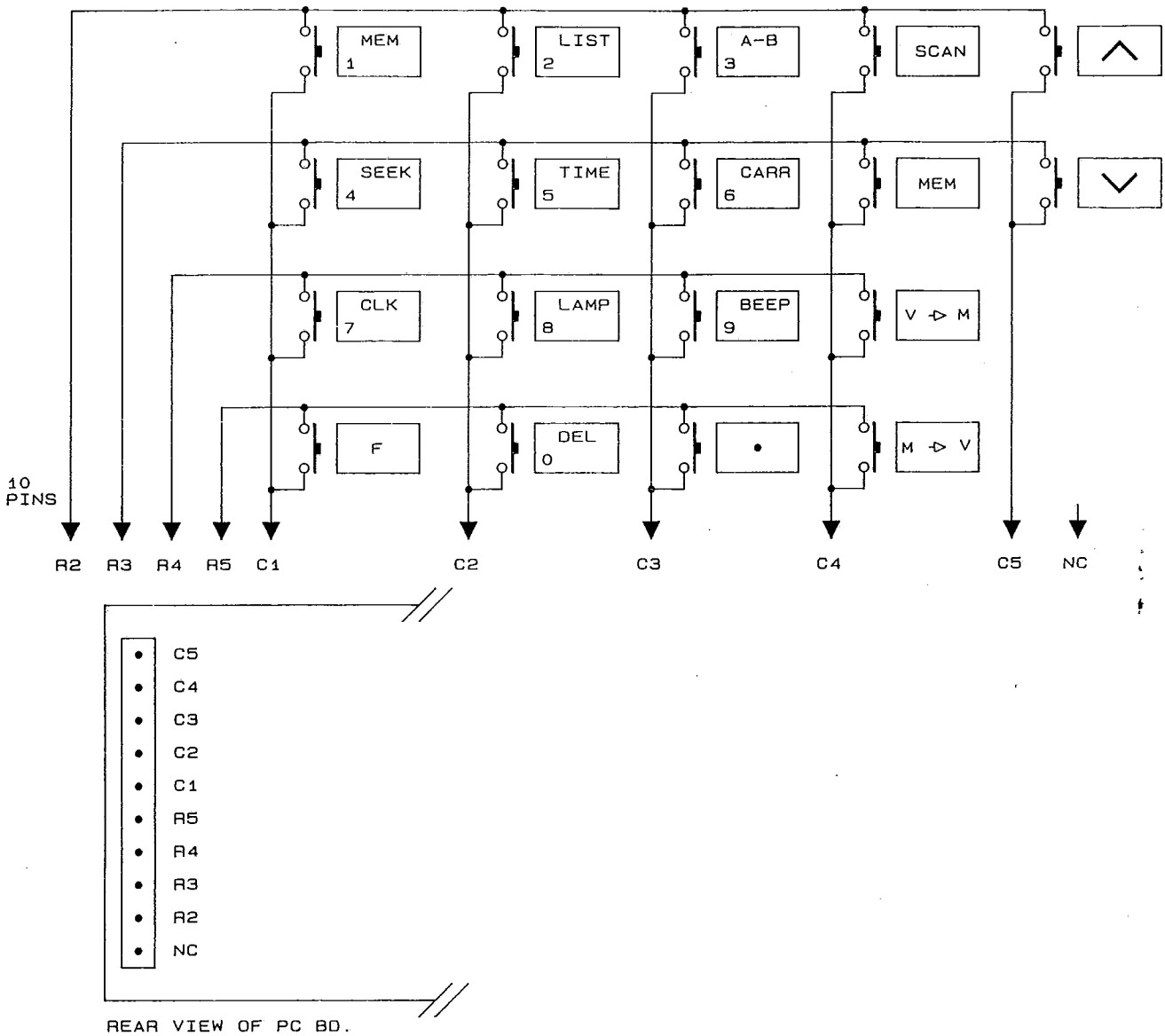
The display is a 4 backplane LCD, controlled by a NEC 7225 driver. The driver is serially loaded using U104 pins 37 and 38, and contains the actual display memory. The 111 display segments are partitioned into three groups and data for each group is updated once every 75 msec. Controller U104 sets the LED backlight for the display by using two lines from U103 to control the current through the LEDs. Note that the synchro LED is driven directly by the synchronous detector circuitry.

Outputs for the RS232 interface serial port are provided by U107 and U112, while inputs are direct to U104. The DTE RDY line is used only for detecting the presence of a terminal, while RTS and CTS provide the handshaking for proper data transmission. When a terminal is detected by a low at U113 pin 17, the software stops scanning the front panel keypad and begins providing handshaking signals on the CTS line. Thus, the keypad is disabled when a terminal puts the DTE RDY line low. All bit timing and formatting for 9600 baud, even parity, 1 start bit, and 1 stop bit is done internally by the controller. U118 provides inversion and level shifting to translate 0-5 volt logic to +/- 10 volt RS232 signals. Pin 1 of J104 provides a 0-5 VDC carrier detect signal for use in scanning from a terminal or PC.

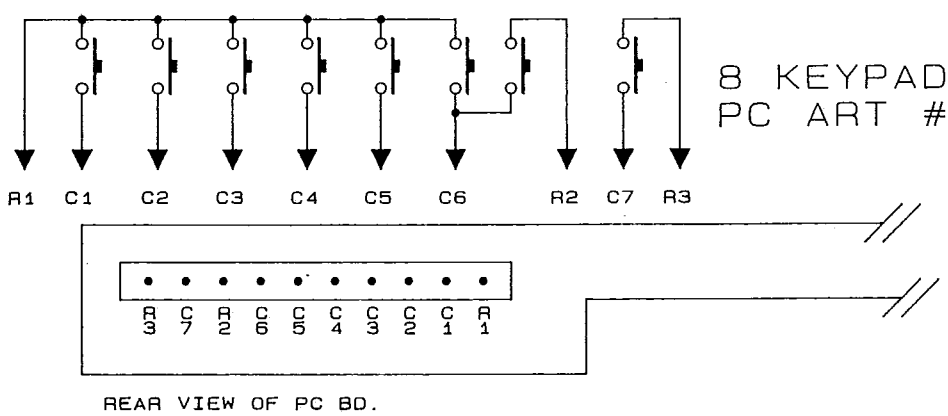
FRONT PANEL BOARD PARTS LIST

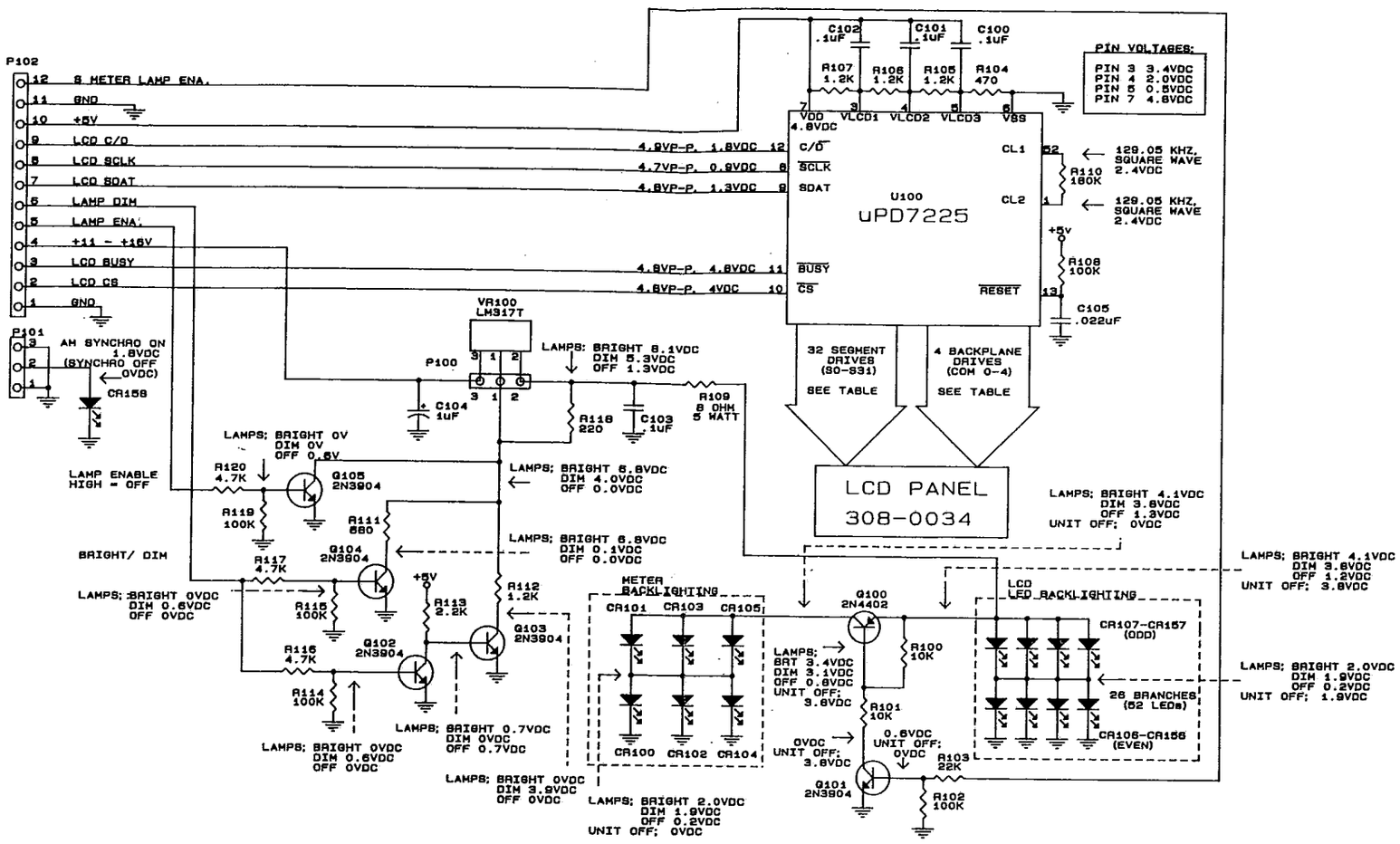
REF	PART NUM	DESCRIPTION
C100	3151648	CAP AX.10 MF 50V
C101	3151648	CAP AX.10 MF 50V
C102	3151648	CAP AX.10 MF 50V
C103	3151648	CAP AX.10 MF 50V
C104	3180012	CAP ELECTRO 1 @ 50 20%
C105	3151582	CAP AXIAL .022 MF 30% Y5P
P100	3280723	CONN P.C. 3 PIN MALE
P101	3280723	CONN P.C. 3 PIN MALE
P102	3280719	CONN. P.C. 12 PIN MALE
Q100	3030121	TRANSISTOR 2N4402
Q101	3030104	TRANSISTOR 2N3904
Q102	3030104	TRANSISTOR 2N3904
Q103	3030104	TRANSISTOR 2N3904
Q104	3030104	TRANSISTOR 2N3904
Q105	3030104	TRANSISTOR 2N3904
R100	3220235	RES C.FILM 10 K 5% 1/4W
R101	3220235	RES C.FILM 10 K 5% 1/4W
R102	3220315	RES C.FILM 100 K 5% 1/4W
R103	3220260	RES C.FILM 22 K 5% 1/4W
R104	3220110	RES C.FILM 470 OHM 5% 1/4W
R105	3220170	RES C.FILM 1.2 K 5%1/4W
R106	3220170	RES C.FILM 1.2 K 5% 1/4W
R107	3220170	RES C.FILM 1.2 K 5% 1/4W
R108	3220315	RES C.FILM 100 K 5% 1/4W
R109	3250109	RES W.W. 8.0 OHM 10% 5W
R110	3220325	RES C.FILM 180 K 5% 1/4W
R111	3220140	RES C.FILM 680 OHM 5% 1/4W
R112	3220170	RES C.FILM 1.2 K 5% 1/4W
R113	3220190	RES C.FILM 2.2 K 5% 1/4W
R114	3220315	RES C.FILM 100 K 5% 1/4W
R115	3220315	RES C.FILM 100 K 5% 1/4W
R116	3220210	RES C.FILM 4.7 K 5% 1/4W
R117	3220210	RES C.FILM 4.7 K 5% 1/4W
R118	3220075	RES C.FILM 220 OHM 5% 1/4W
R119	3220315	RES C.FILM 100 K 5% 1/4W
R120	3220210	RES C.FILM 4.7 K 5% 1/4W
U100	3040155	I.C. UPD7225
CR100	3472065	GREEN L.E.D. LITE-ON LTL 4231-001 (or equivalent)
.	.	.
.	.	.
.	.	.
CR157	3472065	GREEN L.E.D. LITE-ON LTL 4231-001
CR158	3472064	RED L.E.D. LITE-ON LTL 4231 (or equivalent)
VR100	3040102	I.C. LM317T

18 KEYPAD SCHEMATIC - PC ART D-7977



8 KEYPAD SCHEMATIC PC ART #D-7977





CONTROLLER		LCD				
Pin #	uP7225	Pin #	COM 0	COM 1	COM 2	COM 3
15	COM 0	1	COM 0	–	–	–
16	COM 1	2	–	COM 1	–	–
17	COM 2	3	–	–	COM 2	–
15	COM 0	4	COM 0	–	–	–
16	COM 3	5	–	–	–	COM 3
19	S0	6	LO BATT	–	–	–
20	S1	7	ERROR	–	–	–
22	S3	8	1D	1E	1B	1F
21	S2	9	–	1C	1B	1A
24	S5	10	2D	2E	2B	2F
23	S4	11	DP1	2C	2B	2A
26	S7	12	3D	3E	3B	3F
25	S6	13	CL1	3C	3B	3A
28	S9	14	DP2	4E	4B	4F
27	S8	15	4D	4C	4B	4A
30	S11	16	5D	5E	5B	5F
29	S10	17	CL2	5C	5B	5A
32	S13	18	6D	6E	6B	6F
31	S12	19	–	6C	6B	6A
35	S15	20	7D	7E	7B	7F
34	S14	21	–	7C	7B	7A
40	S20	22	–	–	MEM	MHz
37	S17	23	8D	8E	8B	8F
36	S16	24	–	8C	8B	8A
39	S19	25	9D	9E	9B	9F
38	S18	26	–	9C	9B	9A
40	S20	27	NOTCH	SCAN	–	–
19	S0	28	–	1	2	3
20	S1	29	–	4	5	6

CONTROLLER				LCD		
Pin #	uP7225	Pin #	COM 0	COM 1	COM 2	COM 3
18	COM 3	30	–	–	–	COM 3
17	COM 2	31	–	–	COM 2	–
41	S21	32	[A]	[B]	–	–
42	S22	33	#1	–	–	–
42	S22	34	–	–	#3	#2
42	S22	35	#1	–	–	–
42	S22	36	–	–	#3	#2
43	S23	37	[2]	[1]	–	[CONV]
44	S24	38	[NB]	[N]	–	[]
45	S25	39	[TIMER]	[OFF]	–	[ON]
46	S26	40	[ATTN]	[OFF]	–	[PRE]
42	S22	41	#1	–	–	–
42	S22	42	–	–	#3	#2
47	S27	43	[FAST]	–	[SLOW]	[OFF]
42	S22	44	#1	–	–	–
18	COM 3	45	–	–	–	COM 3
17	COM 2	46	–	–	COM 2	–
42	S22	47	–	–	#3	#2
42	S22	48	#1	–	–	–
48	S28	49	[2.3]	[6.0]	–	[0.6]
42	S22	50	#1	–	–	–
49	S29	51	[4.0]	–	–	[1.8]
42	S22	52	–	–	#3	#2
42	S22	53	#1	–	#3	#2
50	S30	54	[LSB]	[AM]	[CW]	–
42	S22	55	#1	–	–	–
51	S31	56	[USB]	–	[FM]	[RTTY]
–	–	57	–	–	–	–
15	COM 0	58	COM 0	–	–	–

#1 : A, B, 1, 2, CONV, PRE, ATTN, OFF, SLOW, FAST, OFF, 0.6, 2.3, 1.8, 6.0, 4.0, LSB, USB, CW, RTTY, AM, FM, | | | |.

#2 : VFO, ANT, RF, AGC, BW-KHZ, MODE.

#3 : A=B, NB, TIMER, NOTCH, STEP, LOCK.

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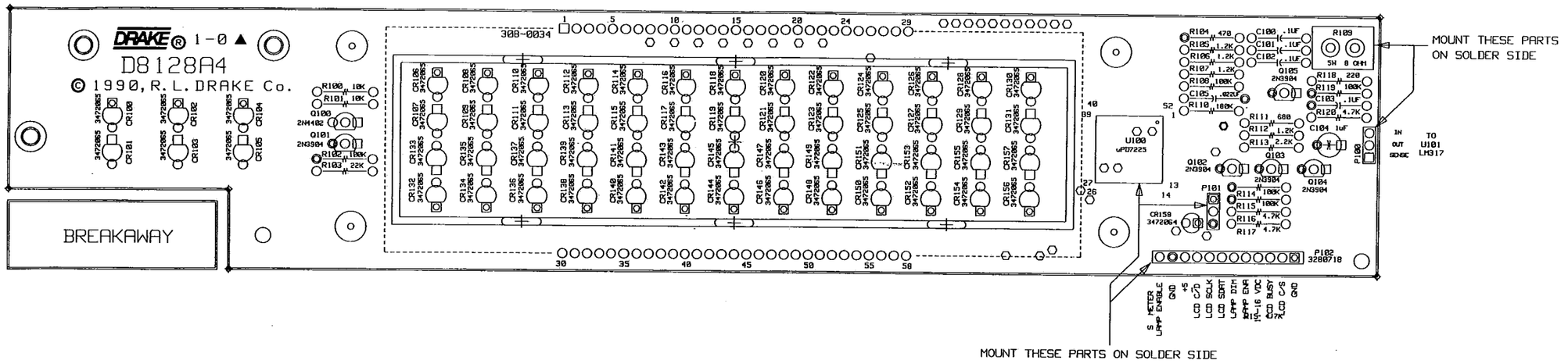

ASSEMBLY NOTES

1. NOTE THE ITEMS INDICATED THAT ARE INSTALLED ON THE CIRCUIT SIDE.

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-11000, -2000

ALIGNMENT

I. POWER SUPPLY VOLTAGE CHECKS AND SETTING CLOCK/ TIMER

A. Power Supply Voltage Check

1. With the R8 unit turned on, measure the following voltage busses at 108 volts and 132 volts AC Line voltage. Measure at 216 volts and 265 volts AC Line voltage for R8E.

Switched unregulated	= 11.7 min	14.3 max
10 volts	= 9.5 min	10.5 max
5 volts	= 4.75 min	5.25 max
-5 volts	= -4.50 min	5.50 max

B. Setting Oscillator for Clock/Timer

1. Jumper tpgether pins 1 and 2 of test connector P-105, and connect a reciprocal counter to this jumper.

2. Adjust trimmer C-402 for a counter reading of 16.00000 Hz.

3. Remove the shorting jumper on test terminals of P105 installed in step 1.

II. SYNTHESIZER AND PBT ALIGNMENT AND TEST

A. 35 MHz Reference Oscillator

1. Attach an accurate counter to PIN 1 of U-130 on the synthesizer board and adjust coil L-155 for a frequency of 35.00000 MHz ± 10 Hz.

2. Using an accurate oscilloscope, measure the level at pin 1 of U-130 with the counter load removed. It should measure at least 1 volt PTP, with 1.5 volts PTP being typical.

3. Using the oscilloscope, measure the level at J-105. Again, it should measure at least 1 volt PTP, with 1.5 volts PTP being typical.

4. Using the counter, measure the frequency at J-105. The frequency should be 3.5 MHz ± 10 Hz.

5. Using the oscilloscope, measure the level of the 70 MHz signal at pin 5 of U-128. Adjust the yellow coil L-154 for maximum level. The level must be greater than 100 mV PTP and is typically 200 mV PTP.

B. PBT Adjustments

1. Ground the center pin of the "Factory Test" connector P-108. (Center pin connects to pin 29 of the uP through a 470 ohm resistor). This causes the frequency up and down buttons to control the PBT tuning voltage.

2. Preset the front panel PBT control to the 12:00 o'clock position.

3. Attach a high impedance voltmeter to the PBT tuning voltage line (pin 1 of U110A) and adjust the frequency up and down buttons for maximum voltage. Then adjust the Full Scale Set DAC pot (R-348) for 8 volts.

4. Adjust the frequency up and down buttons for minimum voltage. Then adjust the Zero Set DAC pot (R356) for 2 VDC ± 0.1 VDC. This step will interact with step 3. Thus, repeat step 3 and 4 until no further improvement can be obtained.

5. Attach an accurate counter to the 2nd LO output jack (J107) and, using the frequency up and down buttons, adjust the PBT voltage to 5 volts ± 0.1 volt. Then adjust the 22.525 MHz PBT oscillator coil (L-131) for a counter frequency of 45.05 MHz ± 100 Hz.

6. Using the oscilloscope, measure the level of the 45.05 MHz signal at the junction of C-380 and C-379. Adjust 3 violet coils L-138, L-139, and L-151 for maximum level. Approximately 1 volt PTP should be seen here after these coils are tuned.

7. Measure the RF voltage at the 2nd LO output jack (J-107), and adjust L-138, L-141, and L-152 for maximum level. After these coils are tuned, typical voltage swing on the oscilloscope would be:

1.5 V PTP if J-107 is loaded with 50 ohms.
2.5 V PTP if J-107 is unloaded.
Minimum level is 1.0 V PTP with J-107 loaded.

8. Store the PBT offsets for each mode by using the following procedure:

(a) Select the desired mode using the MODE button on the front panel.
(b) Select the desired frequency using the frequency up and down buttons.
(c) Once the frequency is selected, store the offset using the "V -> M" button.
(d) Repeat these steps for each mode as indicated in the following table:

MODE	FREQ
AM	45.0500 MHz
FM	45.0500 MHz
USB	45.0486 MHz
LSB	45.0514 MHz
CW	45.0492 MHz
RTTY	45.0522 MHz

(e) After having completed the above steps, the jumper on the "Factory Test" connector should be removed. This will return the frequency up and down buttons to the function of changing the receiver frequency as opposed to the PBT frequency.

C. Loop 3 Adjustments

1. Use the front panel controls to set the frequency of the unit to 7.00000 MHz.

2. Adjust the loop 3 VCO coil (L-134) for a tuning voltage of 5 VDC ± 0.1 VDC as measured at the junction of 22K ohm resistor R-209 and 680 ohm resistor R-227. Insure that the VCO is running at 65.1 MHz by measuring with a counter at pin 11 of U-128.

3. Set the frequency to 7.49999 MHz in CW mode and ensure that the VCO frequency is 65.0 MHz and the tuning voltage is greater than 4.0 VDC and less than 5.0 VDC.

4. Attach a scope and counter to pin 11 of mixer IC U-129 through a high impedance probe and adjust the three yellow coils (L-123, L-128, and L-129) to produce peak output at 63.5 MHz. The level after peaking should be approximately 100 mV PTP.

D. Loop 2 Adjustments

1. Adjust the loop 2 oscillator coil (L-135) for a VCO tuning voltage of 6 VDC ± 0.1 VDC as measured at the junction of 22K ohm resistor R-210 and 680 ohm resistor R-232.

2. Verify that the oscillator frequency is 61 MHz, measured with a counter and a high impedance probe at pin1 of U-123.

3. Set the frequency to 7.50000 MHz in the CW mode and ensure that the VCO frequency is 60 MHz and the tuning voltage is greater than 3.0 VDC and less than 6.0 VDC.

4. Measure the 3.49 MHz signal level at pin 8 of U-126 and repeak the three yellow coils (L-123, L-128, and L-129) for maximum level. Approximately 1.5 volts PTP should be observed at this point.

5. Pre-tune VCO-1 coil (L-108), 3.5 turns down from flush with top of shield can. Set frequency to 7.49999 MHz in the CW mode.

6. Measure the 11.4 MHz level at pin 1 of U-109 using an oscilloscope with high impedance probe and adjust the three violet coils L-120 thru L-122 for maximum level. Approximately 2 volts PTP should be seen at this point.

E. Loop 1 Adjustments

1. Tune radio to 7.49999 MHz (VCO at 52.49999 MHz) and adjust the low band (VCO-1) VCO coil (L-108) so that the tuning voltage is 8.05 ± 0.05 VDC as measured at the junction of 2.2K ohm resistor R-154 and 1K ohm resistor R-142. Measure the VCO frequency at J 100. The frequency should be 52.49999 MHz

2. Tune the radio to 0.10000 MHz (VCO at 45.10000 MHz) and insure that the tuning voltage is greater than 3.0 VDC. (For R8E model, tune the radio to 0.15000 MHz (VCO at 45.15000 MHz) and insure that the tuning voltage is greater than 3.05 VDC.)

3. Tune the radio to 14.99999 MHz (VCO at 59.99999 MHz) and adjust the low-mid band (VCO-2) VCO coil (L-110) so that the tuning voltage is 8.05 VDC ± 0.05 VDC as measured at the junction of 2.2K ohm resistor R-165 and 1K ohm resistor R-143.

4. Tune the radio to 7.50000 MHz (VCO at 52.00000 MHz) and insure that the tuning voltage is greater than 3.0 VDC.

5. Tune the radio to 21.99999 MHz (VCO at 66.99999 MHz) and adjust the hi-mid band (VCO-3) VDC coil (L-112) so that the tuning voltage is 8.05 VDC ± 0.05 VDC as measured at the junction of 2.2K ohm resistor R-165 and 1K ohm resistor R-144.

6. Tune the radio to 15.00000 MHz (VCO at 60.00000 MHz) and insure that the tuning voltage is greater than 3.0 VDC.

7. Tune the radio to 30.00000 MHz (VCO at 75.00000 MHz) and adjust the high band (VCO-4) VCO coil (L-114) so that the tuning voltage is 8.05 VDC ± 0.05 VDC as measured at the junction of 2.2K ohm resistor R-154 and 1K ohm resistor R-145.

8. Tune the radio to 22.00000 MHz (VCO at 67.00000 MHz) and insure that the tuning voltage is greater than 3.0 VDC.

9. Measure the VCO output level at J-100 for each frequency listed below. Output level should be 7 dBm ± 3 dB.

0.10000 MHz
7.49999 MHz
7.50000 MHz
14.99999 MHz
15.00000 MHz
21.99999 MHz
22.00000 MHz
30.00000 MHz

F. 50 KHz BFO Checks

1. With the receiver in the CW, SSB, or RTTY modes, measure the output of the 50 KHz phone jack J-106 using an oscilloscope.

2. The level at this point should be approximately 1.5 volts PTP and the frequency should be as shown on the following table +/- .005%.

MODE	FREQ
USB	48.6 MHz
LSB	51.4 MHz
CW	49.2 MHz
RTTY	52.2 MHz

3. Observe that the output at this jack drops to zero on the AM and FM modes.

III. FRONT END BOARD ALIGNMENT AND TEST

A. Check of Front End Bandpass Filters

1. Calibrate a spectrum analyzer and tracking oscillator with a through connection. Set the tracking oscillator level to -30dBm and adjust the top of the screen to -20 dBm, sweeping from 0 to 110 MHz. As an alternate method, a signal generator and RF voltmeter can be used, using the same levels as mentioned above.

2. Connect the tracking oscillator (or signal generator) output to the "ANT 1" jack (J-104).

3. Connect the spectrum analyzer (or RF voltmeter) to P105 so that the 45 MHz IF section is disconnected and Pin 2 of P101 is terminated in 50 ohms.

4. Select each of the 9 front end bandpass filters by tuning the receiver to the frequency listed on the following chart. Filter ripple should not exceed 2 dB and the minimum and maximum frequencies for each filter should be 4 dB +/- .5 dB below the through connection reference set up in step 1.

BAND	FREQUENCY RANGE	RCVR FREQ
1	0.1 - 0.5 MHz	.3 MHz
	(0.15 - 0.5 MHz on R8E)	(.3MHz)
2	0.5 - 1.5 MHz	.7 MHz
3	1.5 - 2.5 MHz	2.0 MHz
4	2.5 - 4.0 MHz	3.5 MHz
5	4.0 - 7.5 MHz	7.0 MHz
6	7.5 -10.5 MHz	9.0 MHz
7	10.5 -15.0 MHz	12.0 MHz
8	15.0 -22.0 MHz	20.0 MHz
9	22.0 -30.0 MHz	28.0 MHz

5. The sketch shown below gives an approximate representation of how each filter should appear on the spectrum analyzer.

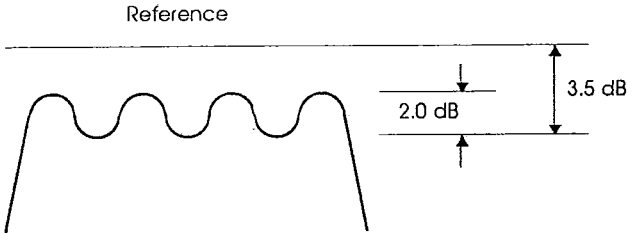


Figure 1.

B. With the 22-30 MHz band selected, enable the **attenuator** and check for a 10 dB drop in spectrum analyzer or RF voltmeter response. Then disable the attenuator.

C. Enable the **preamp** and check for a 10 dB increase in spectrum analyzer or RF voltmeter response. Then disable the preamp.

D. Antenna Switching Checks

1. Select the "ANT 2, 50 OHMS" antenna jack (J105) from the front panel, connect the tracking oscillator or signal generator to J105, and repeat steps B and C.

2. Connect the tracking oscillator or signal generator to the "ANT 2, 500 OHMS" antenna jack (J3) using an appropriate impedance adaptor, and repeat steps B and C. This test can also be performed at the 500 ohm terminal, but a 50-500 ohm balun must be used for proper impedance matching.

3. Temporarily connect pins 1 and 4 on P-109 together with a 10K resistor. This fools the µP into thinking that a VHF board is installed. Select the "VHF CONV, 50" jack from the front panel and connect the tracking oscillator or signal generator to the "VHF CONV, 50" jack. Then repeat steps B and C. Remove the 10K Ohm short connecting pins 1 and 4 of P-109.

F. 45 MHz IF Section Alignment And Tests

1. Calibrate a spectrum analyzer and tracking oscillator (or signal generator and RF voltmeter with 50 ohm termination) with a thru connection. Set the tracker level at -40 dBm and adjust the top of the screen reference for -20 dBm, centered on 45 MHz, 10 KHz per division.

2. Connect the tracking generator (or signal generator) output to the Pin 2 of P-104 which connects to the crystal filter section input. Pin 3 of P-104 which connects to the SBL-3 mixer output, should not be connected to anything.

3. Connect the spectrum analyzer (or RF voltmeter) to the terminal of P-102 which attaches to the output of the crystal filter. The pin connecting to the input of the next stage should not be connected to anything.

4. Tune trimmer capacitor C-197 for maximum response, and alternately adjust L-132, L-131, and if required, C-197 for best response. The response should appear as shown in the sketch which follows. Note that the ideal response would be flat. However, tilt, as shown in the sketch, is the more likely response and is acceptable within the limits shown.

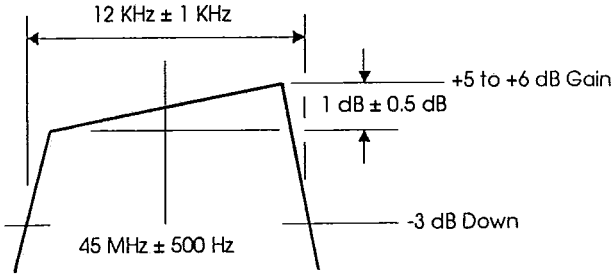


Figure 2.

5. Disconnect the spectrum analyzer from P-102 and connect to the P-103 terminal which connects to the output of the 45 MHz IF section. The center terminal which connects to the next section should not be connected to anything. Adjust the spectrum analyzer for a -10 dBm reference (add 10 dB of attenuation).

6. Add a shorting shunt to P-102 so as to connect the two ungrounded pins.

7. Adjust the front panel RF Gain control until the AGC voltage as measured on pin 5 of P-106 is 0 volts.

8. Adjust trimmer cap C-174 for maximum response.

9. Alternately adjust C-178, C-179, for best response as illustrated in Figure 2.

10. Advance the RF Gain to the fully clockwise position and note that the minimum gain between P-104 and P-103 is +25 dB. Then rotate the RF Gain control counterclockwise and observe that the gain can be reduced a minimum of 40 dB. (In other words, stage gain should be variable from approximately -15 dB to +25 dB). Also check for lack of passband shape distortion over the AGC range.

11. Remove the test equipment from P-104 and insure that jumpers are installed on P-105, P-104, and P-102 so as to establish a signal path from the antenna up to P-103.

F. Image Reject Mixer Section Alignment And Tests

1. Calibrate a spectrum analyzer and a signal generator by establishing a thru connection between the generator and the analyzer. Set the generator level to -20 dBm and adjust top of the screen reference for -20 dBm. Accurately set the frequency of the signal generator to 45 MHz.

2. Connect the signal generator to P-103. The stages proceeding P-103 should be disconnected.

3. Connect the spectrum analyzer input to 50 KHz output jack J103, and make sure that 45.05 MHz signal is being supplied to 2nd LO IN jack J102 at a level of approximately +10 dBm.

4. Locate the 50 KHz output response on the spectrum analyzer, and tune capacitors C-188 and C-191 for maximum response.

5. Switch the signal generator frequency to 45.1 MHz and retune C-188 and C-191 for minimum.

6. Repeat steps 4 and 5 for maximum rejection at 45.1 MHz input and maximum output at 45.0 MHz input. **The minimum rejection should be 30 dB.**

7. Set signal generator to 45 MHz and check for a maximum insertion loss of 10 dB.

8. Remove generator and spectrum analyzer, and connect a jumper on P-103 so that it connects the output of the 45 MHz IF section to the Image Reject Mixer section input.

G. F.M. Detector Alignment And Checks

1. Connect a SINAD meter and a 4 ohm load to the receiver's audio output.

2. Connect a signal generator to the ANT 1 terminal (J-104) and set for 29 MHz, -50dBm output, FM modulated, 1 KHz tone, 3.5 KHz deviation. Tune the receiver to 29 MHz, select the FM mode.

3. Insure that jumpers are in place on P-105, P-104 and P-102 so as to establish a signal path through the receiver to the FM detector.

4. Connect a counter (high impedance input) to pin 20 of the MC3362 IC (U-100) and adjust L-111 for 34.300 MHz +/- 10 Hz.

5. Connect a counter (high impedance input) to pin 4 of the MC3362 IC (U-100) and adjust C-132 for 10.244 MHz +/- 10 Hz.

6. A 1 KHz tone should be heard at the output of the receiver.

7. Adjust the generator level to -100 dBm and adjust FL-101 for best SINAD.

8. Reduce generator level to -113 dBm and adjust C-160 for best SINAD.

9. Check for a minimum of 12 dB SINAD at -113 dBm input.

H. FM Squelch Adjustment

1. With equipment still connected as per the proceeding section, switch the signal generator level "off".

2. Adjust the FM signal level threshold pot (R-117 on the Front End board) to read 2.0 volts DC on pin 7 of the LM358 IC (U-101).

3. Set the signal generator output to +60 dB above 0.5 uv (-55 dBm) and set the FM Full Scale Pot (R-374 -- 100K ohms on 2nd IF/Audio board) for full scale S-Meter reading.

IV. SECOND I.F./ AUDIO BOARD TUNE UP AND TEST

A. 50 KHz IF Filter Tune Up

Prerequisites

(1.) Digital control inputs
(2.) 50 KHz Spectrum Analyzer and Tracking Generator
(3.) Buffer from output MOSFET (Q2) to Analyzer (input impedance 2 K ohms or higher at 50 KHz).
(4.) 50 KHz ± 10 Hz source at approximately -30 dBm.

1. Connect tracking generator to the IF input jack (J-3) and select the narrowest bandwidth (i.e. 500 Hz) with the digital control inputs.

2. A low level peak should be visible on the analyzer display. Adjust the tuning slugs on all of the pot cores to peak the response. Ensure that the output is not into compression which will cause flattening of the passband. Repeak if necessary.

3. Select 2.3 KHz bandwidth and note the symmetry about 50 KHz. Select 4 KHz bandwidth and note symmetry about 50 KHz. The symmetry about 50 KHz will not be perfect but ripple peak symmetry across the band should be obtained.

4. Switch back to the 2.3 KHz bandwidth and, if needed, touch up the necessary pot cores that affect the response only a minimum amount so that the 500 Hz bandwidth is not grossly affected. Switch to the 500 Hz bandwidth. The peak of the response should be within 4 dB of the 2.3 KHz bandwidth's response. If not, readjust.

5. Switch to the 4 KHz bandwidth and adjust the necessary pot cores that flatten the passband as above. Ripple should be maintained below 2.9 dB PTP. The -6 dB points may end up slightly skewed to the low side when done. Switch to the 500 Hz bandwidth. The peak of the response should be within 4 dB of the 4 KHz bandwidth's peak. If not, readjust.

6. Step through all BW's noting symmetry, passband flatness, and relative loss. Relative loss between any two bandwidths should be less than 5 dB. The -6dB bandwidth should be within +/-10% except on 500 Hz bandwidth where bandwidths over 370 Hz are acceptable. All shape factors (-6 dB/-60dB) should be less that 1:2.2 except for the 500 Hz bandwidth where anything less than 1:40 is acceptable.

B. A.G.C. and S-Meter Setup

The Signal Generator referred to in this section is attached to the antenna 1 input.

Preset the follwing pots as indicated.

Preset AGC 1 (R-325) to 2.8 VDC at Pin 1 of U-116A
Preset AGC 2 (R-382) to 4.1 VDC at Pin 7 of U-116A
Preset IF Gain (R-209) to the "12 O'clock" position
Preset Full Scale (R-336) to the "4 O'clock" position

1. Select the AM mode with the frequency set to 14.2 MHz. Preamp should be off.

2. Set the signal generator level for -103 dBm at 60% AM modulation with a 1 KHz tone.

3. Adjust the IF gain pot (R-209) for an S-3 reading on the S-meter.

4. Set the Signal Generator level for -13 dBm.

5. Adjust the S-Meter Full Scale pot (R-336) for a +60 dB/S-9 reading on the S-meter.

6. Set the signal generator level for -73 dBm.

7. Adjust the AGC 1 set pot (R-325) for an S-9 reading on the S-meter.

8. Repeat steps 3 through 7 until no further improvement can be made.

9. Set the signal generator level for -53 dBm.

10. Adjust the AGC-2 set pot (R-382) for a +20 dB/S-9 reading on the S-meter.

11. Repeat steps 3-10, if necessary, until little additional improvement in S-meter tracking is obtained. With an S-9 reading obtained at a -73 dBm generator input level, increases of signal level input in 10 dB steps should result in S-meter tracking for +10, +20, ... +60/S-9 readings.

C. SSB-AM Squelch Setup

1. Select AM mode, and set the frequency as desired.

2. Set the signal generator to the same frequency as the receiver.

3. Set the level for +50 dB/S-9 on the S-meter.

4. Set the front panel Squelch pot for full clockwise rotation (maximum squelch level).

5. Adjust the squelch threshold pot (R-115) until the receiver just squelches and then back it off until the receiver just unsquelches.

D. Recovered Audio Output Tests

Prerequisites

(1.) I.F. filter has been tuned.
(2.) 4 ohm load for external speaker, > = 4.7 K ohm load for line outputs.
(3.) Oscilloscope
(4.) -50 dBm 50 KHz signal 100% AM modulated with 1 KHz sinewave.
(5.) Volume pot, RF Gain pot, Tone pot. (These items will be connected already if board is installed in a receiver unit).

1. Preset POWER on, NB off, FM disabled, AGC slow, AGC enabled, BFO disabled, SYNCH DET disabled, NOTCH disabled.

2. Set the BW to 6 KHz, VOLUME to max, EXTERNAL SPEAKER selected, TONE to midrange, and RF GAIN to maximum.

3. Input the modulated 50 KHz signal into the IF strip through phono jack.

4. Monitor with an oscilloscope the 1 KHz demodulated sinewave dropped across the 4 ohm load.

5. With the VOLUME control at maximum, adjust the detector gain pot (R-139) to obtain a 8 Volt PTP undistorted sinewave across the 4 ohm load. This is equivalent to 2.37 watts.

6. Check the two line audio outputs for at least .85 Volts PTP sinewaves into 4.7K ohm loads. This is equivalent to approximately 300 mv rms.

E. Synchronous Detector Setup

1. Select AM mode, and set the frequency as desired.

2. Center the PBT pot to 12 o'clock.

3. Set the signal generator to the same frequency as the receiver, and set the level for -50 dBm.

4. Adjust the VCO center frequency pot (R-285) for 2.5 VDC +/- 0.01 V on pin 9 of IC U-112.

5. Attach an oscilloscope to pin 3 of U-109 and reduce the signal generator level to zero.

6. Asjust R-158 for 50% duty cycle of the observed square wave. Then remove oscilloscope.

7. Adjust the Signal Generator level to a level 20 dB below the AGC threshold and engage synchro detector. Observe that it locks up satisfactorily and that the front pane SYNCHRO LED comes on.

F. Notch Null Adjustments

Prerequisites

(1.) Place unit in SSB mode and tune in an external signal generator signal for a beat note at 1.5 KHz.
(2.) Enable Notch.

1. With the above 1.5 KHz sinewave displayed on an oscilloscope connected to the audio output, and the front panel NOTCH control fully clockwise, adjust the level so that the signal spans the 8 vertical divisions of the oscilloscope.

2. Notch out the signal with the front panel NOTCH control.

3. Adjust the Notch Depth pot (R-184) to further reduce the signal.

4. Repeat steps 2 and 3 for maximum null. The signal should be less than 1/5 of one of the 8 major divisions which corresponds to > 32 dB of attenuation.

5. Check notch at 500 Hz and 3 KHz modulation where attenuation should be greater than 30 dB.

6. Notch attenuation for modulation above 2.5 KHz should be at least 30 dB.

G. Noise Blanker Check and Adjustment

Prerequisites

(1.) I.F. and audio circuits operational
(2.) Signal Generator set for 2.1 MHz at approximately a -95 dBm output level.
(3.) Pulse Generator set for 250 Hz repetition rate, pulse width of 55 usec and output level set to 0.5 - 1.0 Vpp.

1. Combine the signal generator and pulse generator outputs into the 50 ohm antenna input of the R8/R8E receiver. Turn the Power ON to the receiver.

2. Set the receiver for LSB mode, 2.3 KHz BW, AGC slow, Preamp Off, Noise Blanker Off, RF Gain fully clockwise and select the 'Antenna 1' input. Tune the receiver to a frequency of 2.1 MHz.

3. Monitor the audio by connecting an oscilloscope to the External Speaker output at the rear panel of the receiver.

4. With the Pulse generator disabled, but connected to the receiver, tune the R8/R8E to receive a 1 KHz beat note at a received level of 'S5'.

5. Enable the Pulse generator and increase its level to yield a +10dB/S9 S-meter reading on the R8/R8E.

6. Enable the noise blanker. The S-meter reading should reduce to an S-5 reading.

7. Switch to the AM mode and remove both the signal generator and pulse generator inputs. Observe the audio on the oscilloscope. If horizontal bars appear in the receiver noise output, adjust the Noise Blanker Threshold pot (R-363) to a point that the bars are just eliminated. Recheck the blanking as done previously (in step 6) to insure that the noise blanker operates properly. Note that the Trhreshold pot (R-363) is adjusted only to prevent false triggering and has no effect on the blanking depth.

VHF CONVERTER ACCESSORY

VHF BLOCK CONVERTER THEORY OF OPERATION

RF Section

The signal input from the CONV ANT terminal is amplified and filtered as it passes through the preselector. The preselection filters divide the frequencies into two bands: low band and high band. Low band is a fixed band pass filter that passes 35 thru 54 MHz. High band is a voltage tuned band pass filter that covers 108 thru 174 MHz in 15 discrete steps. Both bands share the same amplifiers: Q110 and Q107. The signals mix (MX101: DBM50A) with one of six fixed local oscillator frequencies. This divides the covered RF frequency range into six RF blocks. The RF blocks are:

35 - 54.000 MHz
108 - 124.999 MHz
125 - 138.999 MHz
139 - 151.999 MHz
152 - 163.999 MHz
164 - 174.000 MHz

The converted IF block is passed on to the R8/R8E front end board.

CONTROL

A 35 bit control code is sent from the R8/R8E via the data line. The control code contains the information required to select the correct preselector band, the filter tune voltage, the VCO select bits and the PLL A and N words. The 35 bit control code is fed serially through U105 (74HC595), then through U103 (74HC595) and finally to the PLL chip U102 (MB1504). When all 35 bits have been clocked in, the enable is strobed to latch the data. Now U105 contains the tunable filter code and works in conjunction with RP100 (R/2R SIP) and U106 (LPC662) as a D/A converter to generate the filter tune voltage. U103 (74HC595) contains the band select bits for the preselector filters and PLL VCO's. U102 is set up for the desired LO frequency.

SYNTHESIZER

The synthesizer is a single loop design that is phased locked to the 3.5 MHz crystal reference from the R8/R8E. The heart of the synthesizer is U102 (MB1504). The VCO signal is fed back through the buffer Q101 to U102 where it is compared with the reference, this generates an error voltage which is sent to the loop filter. The output of the loop filter controls the VCO frequency so that it maintains lock to the crystal reference. The locked VCO signals are sent through the buffer amp Q106 to drive the LO port of MX101.

REF	PART NUM	DESCRIPTION
C101	3180125	CAP ELECTRO 47@16 RADIAL
C102	3151649	CAP RAD .10 MF 50V
C103	3151649	CAP RAD .10 MF 50V
C104	3151649	CAP RAD .10 MF 50V
C105	3151649	CAP RAD .10 MF 50V
C106	3180125	CAP ELECTRO 47@16 RADIAL
C107	3151587	CAP AX .047 MF +80-20 Z5U
C108	3164165	CAP DISC 680 10% Y5P 50V
C109	3151649	CAP RAD .10 MF 50V
C110	3151649	CAP RAD .10 MF 50V
C111	3164190	CAP DISC .001 22% Z5U 50V
C112	3151515	CAP AXIAL .01 MF 20% Y5P
C113	3180125	CAP ELECTRO 47@16 RADIAL
C114	3151649	CAP RAD .10 MF 50V
C115	3164027	CAP DISC 27.0 5% NPO 50V
C116	3151649	CAP RAD .10 MF 50V
C117	3164020	CAP DISC 20.0 5% NPO 50V
C118	3151649	CAP RAD .10 MF 50V
C119	3164018	CAP DISC 18.0 5% NPO 50V
C120	3151649	CAP RAD .10 MF 50V
C121	3164010	CAP DISC 10.0 5% NPO 50V
C122	3164022	CAP DISC 22.0 5% NPO 50V
C123	3164027	CAP DISC 27.0 5% NPO 50V
C124	3164018	CAP DISC 18.0 5% NPO 50V
C125	3164015	CAP DISC 15.0 5% NPO 50V
C126	3164012	CAP DISC 12.0 5% NPO 50V
C127	3164010	CAP DISC 10.0 5% NPO 50V
C128	3164008	CAP DISC 8.2 5% NPO 50V
C129	3164010	CAP DISC 10.0 5% NPO 50V
C130	3164003	CAP DISC 2.7 5% NPO 50V
C131	3164010	CAP DISC 10.0 5% NPO 50V
C132	3164003	CAP DISC 2.7 5% NPO 50V
C133	3164006	CAP DISC 6.8 5% NPO 50V
C134	3180125	CAP ELECTRO 47@16 RADIAL
C135	3164010	CAP DISC 10.0 5% NPO 50V
C136	3151649	CAP RAD .10 MF 50V
C137	3164010	CAP DISC 10.0 5% NPO 50V
C138	3151649	CAP RAD .10 MF 50V
C139	3164010	CAP DISC 10.0 5% NPO 50V
C140	3151649	CAP RAD .10 MF 50V
C141	3164010	CAP DISC 10.0 5% NPO 50V
C142	3151649	CAP RAD .10 MF 50V
C143	3151649	CAP RAD .10 MF 50V
C144	3164165	CAP DISC 680 10% Y5P 50V
C145	3151649	CAP RAD .10 MF 50V
C146	3164047	CAP DISC 47.0 5% NPO 50V
C147	3151515	CAP AXIAL .01 MF 20% Y5P
C148	3164150	CAP DISC 150 10% Y5P 50V
C149	3164190	CAP DISC .001 22% Z5U 50V
C150	3164020	CAP DISC 20.0 5% NPO 50V
C151	3164020	CAP DISC 20.0 5% NPO 50V
C152	3151649	CAP RAD .10 MF 50V
C153	3164190	CAP DISC .001 22% Z5U 50V
C154	3164047	CAP DISC 47.0 5% NPO 50V
C155	3164190	CAP DISC .001 22% Z5U 50V
C156	3151649	CAP RAD .10 MF 50V
C157	3151649	CAP RAD .10 MF 50V
C158	3164145	CAP DISC 120 10% Y5P 50V
C159	3164047	CAP DISC 47.0 5% NPO 50V
C160	3151649	CAP RAD .10 MF 50V
C161	3164145	CAP DISC 120 10% Y5P 50V
C162	3164165	CAP DISC 680 10% Y5P 50V
C163	3151649	CAP RAD .10 MF 50V
C164	3151649	CAP RAD .10 MF 50V
C165	3151515	CAP AXIAL .01 MF 20% Y5P
C166	3180125	CAP ELECTRO 47@16 RADIAL
C167	3164012	CAP DISC 12.0 5% NPO 50V
C168	3164165	CAP DISC 680 10% Y5P 50V
C169	3180125	CAP ELECTRO 47@16 RADIAL
C170	3164165	CAP DISC 680 10% Y5P 50V
C171	3164027	CAP DISC 27.0 5% NPO 50V
C172	3180125	CAP ELECTRO 47@16 RADIAL
C173	3180125	CAP ELECTRO 47@16 RADIAL
C174	3164153	CAP DISC 180 5% NPO 50V
C175	3151649	CAP RAD .10 MF 50V
C176	3151649	CAP RAD .10 MF 50V
C177	3164153	CAP DISC 180 5% NPO 50V
C178	3164153	CAP DISC 180 5% NPO 50V
C179	3151649	CAP RAD .10 MF 50V
C180	3151649	CAP RAD .10 MF 50V
C181	3164153	CAP DISC 180 5% NPO 50V
C182	3205199	CAP VAR TRIMMER 2.5-12PF
C183	3180125	CAP ELECTRO 47@16 RADIAL
C184	3205199	CAP VAR TRIMMER 2.5-12PF
C185	3180125	CAP ELECTRO 47@16 RADIAL
C186	3151649	CAP RAD .10 MF 50V
C187	3151649	CAP RAD .10 MF 50V
C188	3151649	CAP RAD .10 MF 50V
C189	3151649	CAP RAD .10 MF 50V
C190	3151649	CAP RAD .10 MF 50V
C191	3164165	CAP DISC 680 10% Y5P 50V
C192	3164165	CAP DISC 680 10% Y5P 50V
C193	3151649	CAP RAD .10 MF 50V
C194	3151649	CAP RAD .10 MF 50V
C195	3151649	CAP RAD .10 MF 50V
C196	3164165	CAP DISC 680 10% Y5P 50V
C197	3164165	CAP DISC 680 10% Y5P 50V
C198	3151649	CAP RAD .10 MF 50V
C199	3205199	CAP VAR TRIMMER 2.5-12PF
C200	3205199	CAP VAR TRIMMER 2.5-12PF
C201	3164056	CAP DISC 56.0 5% NPO 50V
C202	3164056	CAP DISC 56.0 5% NPO 50V
C203	3164056	CAP DISC 56.0 5% NPO 50V
C204	3164056	CAP DISC 56.0 5% NPO 50V
C205	3150168	CAP RAD 5.6 10% NPO 50V
J101	3280042	CONN.COAX PC MT.#TMP-J01X-
J102	3280042	CONN.COAX PC MT.#TMP-J01X-
J103	3280042	CONN.COAX PC MT.#TMP-J01X-
L101	2510095	INDUCTOR TOROID
L102	2510094	INDUCTOR TOROID
L103	3524124	COIL VAR 0.046UH BRASS COR
L104	3524124	COIL VAR 0.046UH BRASS COR
L105	3520501	CHOKE ASSY 1.8UH
L106	3520501	CHOKE ASSY 1.8UH
L107	3520501	CHOKE ASSY 1.8UH
L108	3520501	CHOKE ASSY 1.8UH
L109	2510102	INDUCTOR TOROID
L110	3524041	COIL AIR 1-1/2T .125"I.D.
L111	2510102	INDUCTOR TOROID
L112	2510121	INDUCTOR TOROID
L113	2510121	INDUCTOR TOROID
L114	3520503	CHOKE ASSY 2.7 UH
L115	3520503	CHOKE ASSY 2.7 UH
L116	2510122	INDUCTOR TOROID

70 VHF Converter Board Parts List cont'd.

REF	PART NUM	DESCRIPTION
L117	2510122	INDUCTOR TOROID
L118	2510099	INDUCTOR TOROID
L119	2510099	INDUCTOR TOROID
L120	2510089	INDUCTOR TOROID
L121	2510089	INDUCTOR TOROID
L122	2510089	INDUCTOR TOROID
L123	2510089	INDUCTOR TOROID
L124	3520503	CHOKE ASSY 2.7 UH
L125	3520503	CHOKE ASSY 2.7 UH
L126	3520503	CHOKE ASSY 2.7 UH
L127	3520503	CHOKE ASSY 2.7 UH
L128	3520503	CHOKE ASSY 2.7 UH
L129	3520501	CHOKE ASSY 1.8UH
L130	3520501	CHOKE ASSY 1.8UH
L131	3524219	COIL AXIAL .47UH
P100	3280726	P.C. CONNECTOR 6 PIN
Q101	3030283	TRANSISTOR 3SK179
Q102	3030507	TRANSISTOR 2SK192
Q103	3030507	TRANSISTOR 2SK192
Q104	3030507	TRANSISTOR 2SK192
Q105	3030507	TRANSISTOR 2SK192
Q106	3030283	TRANSISTOR 3SK179
Q107	3030302	TRANSISTOR BFR91A
Q108	3030104	TRANSISTOR 2N3904
Q109	3030104	TRANSISTOR 2N3904
Q110	3030302	TRANSISTOR BFR91A
R101	3220610	RES C.FILM 4.7 K 5% 1/4W
R102	3220455	RES C.FILM 100 OHM 5%1/4W
R103	3220713	RES C.FILM 100 K 5% 1/4W
R104	3220695	RES C.FILM 56 K 5% 1/4W
R105	3220415	RES C.FILM 22 OHM 5%1/4W
R106	3220695	RES C.FILM 56 K 5% 1/4W
R107	3220425	RES C.FILM 33 OHM 5%1/4W
R108	3220630	RES C.FILM 8.2 K 5% 1/4W
R109	3220600	RES C.FILM 3.3 K 5% 1/4W
R110	3220595	RES C.FILM 2.7 K 5% 1/4W
R111	3220595	RES C.FILM 2.7 K 5% 1/4W
R112	3220575	RES C.FILM 1.5 K 5% 1/4W
R113	3220435	RES C.FILM 47 OHM 5%1/4W
R114	3220675	RES C.FILM 33 K 5% 1/4W
R115	3220675	RES C.FILM 33 K 5% 1/4W
R116	3220675	RES C.FILM 33 K 5% 1/4W
R117	3220675	RES C.FILM 33 K 5% 1/4W
R118	3220720	RES C.FILM 150 K 5% 1/4W
R119	3220720	RES C.FILM 150 K 5% 1/4W
R120	3220720	RES C.FILM 150 K 5% 1/4W
R121	3220720	RES C.FILM 150 K 5% 1/4W
R122	3220465	RSE C.FILM 150 OHM 5%1/4W
R123	3220720	RES C.FILM 150 K 5% 1/4W
R124	3220720	RES C.FILM 150 K 5% 1/4W
R125	3220720	RES C.FILM 150 K 5% 1/4W
R126	3220720	RES C.FILM 150 K 5% 1/4W
R127	3220485	RES C.FILM 270 OHM 5%1/4W
R128	3220435	RES C.FILM 47 OHM 5%1/4W
R129	3220435	RES C.FILM 47 OHM 5%1/4W
R130	3220435	RES C.FILM 47 OHM 5%1/4W
R131	3220685	RES C.FILM 47 K 5% 1/4W
R132	3220685	RES C.FILM 47 K 5% 1/4W
R133	3220435	RES C.FILM 47 OHM 5%1/4W
R134	3220435	RES C.FILM 47 OHM 5%1/4W
R135	3220435	RES C.FILM 47 OHM 5%1/4W
R136	3220435	RES C.FILM 47 OHM 5%1/4W
R137	3220612	RES C.FILM 5.1 K 5% 1/4W
R138	3220475	RES C.FILM 220 OHM 5%1/4W
R139	3220475	RES C.FILM 220 OHM 5%1/4W
R140	3220475	RES C.FILM 220 OHM 5%1/4W
R141	3220470	RES C.FILM 180 OHM 5%1/4W
R142	3220455	RES C.FILM 100 OHM 5%1/4W
R143	3220425	RES C.FILM 33 OHM 5%1/4W
R144	3220590	RES C.FILM 2.2 K 5% 1/4W
R145	3220475	RES C.FILM 220 OHM 5%1/4W
R146	3220415	RES C.FILM 22 OHM 5%1/4W
R147	3220475	RES C.FILM 220 OHM 5%1/4W
R148	3220590	RES C.FILM 2.2 K 5% 1/4W
R149	3220635	RES C.FILM 10 K 5% 1/4W
R150	3250212	RES C.FILM 220 OHM 5%1/8W
R151	3250212	RES C.FILM 220 OHM 5%1/8W
R152	3250129	RES C.FILM 22 OHM 5%1/8W
R153	3220610	RES C.FILM 4.7 K 5% 1/4W
R154	3220635	RES C.FILM 10 K 5% 1/4W
R155	3220530	RES C.FILM 620 OHM 5%1/4W
R156	3220610	RES C.FILM 4.7 K 5% 1/4W
R157	3220473	RES C.FILM 200 OHM 5%1/4W
R158	3220700	RES C.FILM 68 K 5% 1/4W
R159	3220635	RES C.FILM 10 K 5% 1/4W
R160	3220595	RES C.FILM 2.7 K 5% 1/4W
R161	3220610	RES C.FILM 4.7 K 5% 1/4W
R162	3220595	RES C.FILM 2.7 K 5% 1/4W
R163	3220610	RES C.FILM 4.7 K 5% 1/4W
R164	3220660	RES C.FILM 22 K 5% 1/4W
R165	3220455	RES C.FILM 100 OHM 5%1/4W
R166	3220455	RES C.FILM 100 OHM 5%1/4W
R167	3220660	RES C.FILM 22 K 5% 1/4W
R168	3220660	RES C.FILM 22 K 5% 1/4W
R169	3220455	RES C.FILM 100 OHM 5%1/4W
R170	3220455	RES C.FILM 100 OHM 5%1/4W
R171	3220660	RES C.FILM 22 K 5% 1/4W
R172	3220473	RES C.FILM 200 OHM 5%1/4W
R173	3220505	RES C.FILM 430 OHM 5%1/4W
R174	3220505	RES C.FILM 430 OHM 5%1/4W
R175	3220700	RES C.FILM 68 K 5% 1/4W
R176	3220505	RES C.FILM 430 OHM 5%1/4W
R177	3220505	RES C.FILM 430 OHM 5%1/4W
R178	3250206	RES C.FILM 150 OHM 5%1/8W
R179	3220465	RSE C.FILM 150 OHM 5%1/4W
R180	3220455	RES C.FILM 100 OHM 5%1/4W
R181	3220455	RES C.FILM 100 OHM 5%1/4W
R182	3220465	RSE C.FILM 150 OHM 5%1/4W
R183	3220530	RES C.FILM 620 OHM 5%1/4W
R184	3250206	RES C.FILM 150 OHM 5%1/8W
R185	3250141	RES C.FILM 39 OHM 5%1/8W
R186	3220465	RSE C.FILM 150 OHM 5% 1/4W
R187	3220455	RES C.FILM 100 OHM 5%1/4W
R188	3220455	RES C.FILM 100 OHM 5%1/4W
R189	3220465	RSE C.FILM 150 OHM 5%1/4W

REF	PART NUM	DESCRIPTION
T101	2510100	INDUCTOR TOROID
T102	2510100	INDUCTOR TOROID
T103	2510087	INDUCTOR TOROID
T104	2510087	INDUCTOR TOROID
T105	2510087	INDUCTOR TOROID
T106	2510087	INDUCTOR TOROID
T107	2510093	INDUCTOR TOROID
T108	2510093	INDUCTOR TOROID
T109	2510093	INDUCTOR TOROID
T110	2510093	INDUCTOR TOROID
U101	3040169	I.C. LPC662AIN
U102	3045012	I.C. MB1504
U103	3040018	I.C. 74HC595N
U104	3040016	I.C. 74HC14
U105	3040018	I.C. 74HC595N
U106	3040169	I.C. LPC662AIN
CR101	3024701	VARACTOR 1SV153
CR102	3024701	VARACTOR 1SV153
CR103	3024701	VARACTOR 1SV153
CR104	3024701	VARACTOR 1SV153
CR105	3020050	DIODE 1N751A 5.1V 5% .5W
CR106	3020335	DIODE 1S2186
CR107	3020335	DIODE 1S2186
CR108	3020335	DIODE 1S2186
CR109	3020335	DIODE 1S2186
CR110	3020088	DIODE 1N4099 6.8V 5% .25W
CR111	3020050	DIODE 1N751A 5.1V 5% .5W
CR112	3020050	DIODE 1N751A 5.1V 5% .5W
CR113	3020050	DIODE 1N751A 5.1V 5% .5W
CR114	3024700	VARACTOR 1S2208B
CR115	3024700	VARACTOR 1S2208B
CR116	3024700	VARACTOR 1S2208B
CR117	3024700	VARACTOR 1S2208B
CR118	3020335	DIODE 1S2186
CR119	3020335	DIODE 1S2186
CR120	3020335	DIODE 1S2186
CR121	3020335	DIODE 1S2186
CR122	3020335	DIODE 1S2186
CR123	3020335	DIODE 1S2186
CR124	3020335	DIODE 1S2186
CR125	3020335	DIODE 1S2186
MX101	3045009	I.C. BALANCED MOD DBM50A
RP100	3221066	RES PACK #BLA8-154F R2R 8-BIT
VR101	3040031	I. C. 78L05-ACP
VR102	3040031	I. C. 78L05-ACP

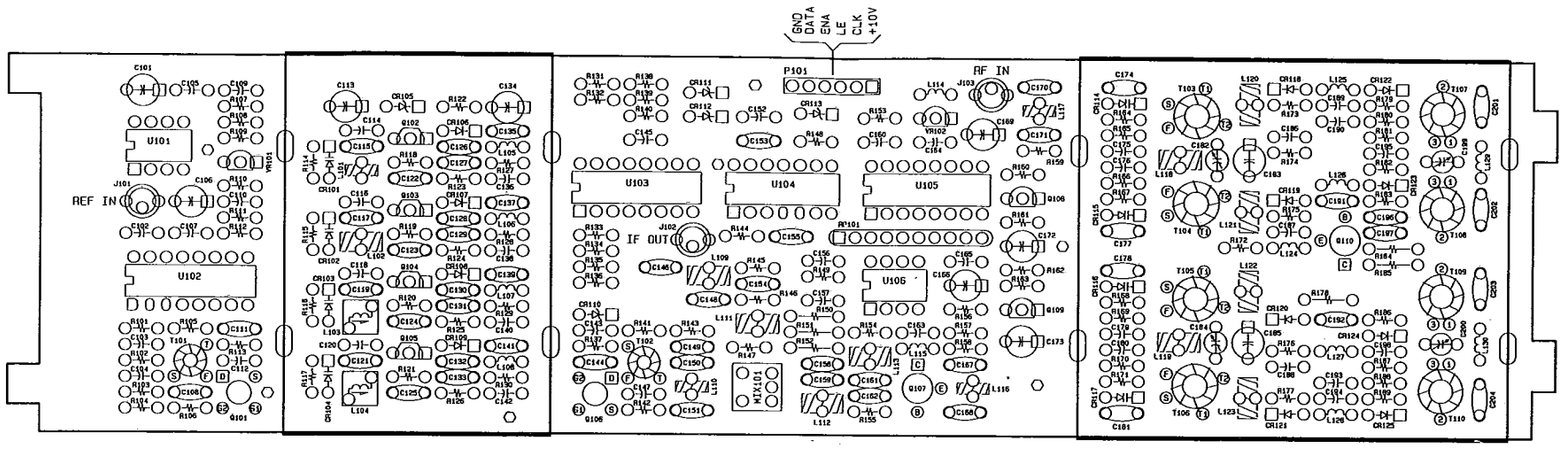
PRESELECTOR

MIXER SECTION

VCO'S

SYNTHESIZER

CONTROL



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VHF CONVERTER ALIGNMENT

VCO Test and Tune

1. Set the R8/R8E to the frequency listed in Table 1.

2. Probe pin 1 of U101A with a DVM set to measure voltage.

3. For VCO1 and VCO2 adjustment is not necessary, however, the voltage should be checked to assure that the loop is in lock.

4. VCO3 and VCO4 should be adjusted at the high end of their tuning range, then checked at the lower end for proper control voltage.

5. Proceed with tuning per Table 1.

R8/R8E FREQUENCY (MHz)	(VOM READING) VERROR	EXECUTE STEPS IN THIS ORDER	ACTION REQUIRED
VCO 1 45	4.0 ± 2.0 V	1	Check voltage at pin 1.
VCO 2 115	4.0 ± 2.0 V	2	Check voltage at pin 1.
VCO 3 145	8.0 ± 0.1 V	3	Tune L103 for desired voltage at pin 1.
VCO 4 132	2.5 ± 0.5 V	4	Check voltage at pin 1.
VCO 5 168	8.2 ± 0.1 V	5	Tune L104 for desired voltage at pin 1.
VCO 6 157	2.0 ± 0.5 V	6	Check voltage at pin 1.

Table 1

Preselector Tuning and Checks

A. Low Band (35 - 54 MHz)

1. Connect a Spectrum Analyzer and Tracking Generator to the VHF Converter so that the Tracking Generator output connects to the Converter Antenna input jack (J-103) and the Spectrum Analyzer input connects to pin 1 of mixer MX101. (See Figure 3).
   (a) Tracking Generator level should be no higher than -30 dBm.
   (b) Spectrum Analyzer settings should be as follows:

Bandwidth	=	300 KHz
Scan Width	=	5 MHz/Division - Low Band
	=	10 MHz/Division - High Band
Input Atten	=	10 dB
Center Freq	=	45 MHz
Scan Time	=	2 mSec
Log Ref	=	0 dBm

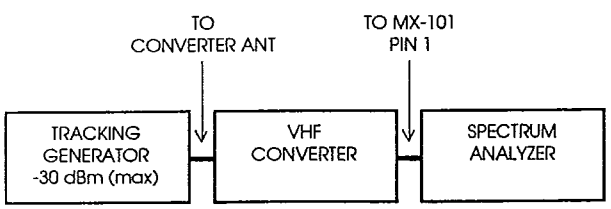

Figure 3

2. Set the R8/R8E to a test frequency 45 MHz. Now the low band filters will be selected and their frequency response displayed on the analyzer.

3. Adjust the trimmer caps (C199 & C200) in the two low band filters until the desired response is achieved (as shown in Figure 4).

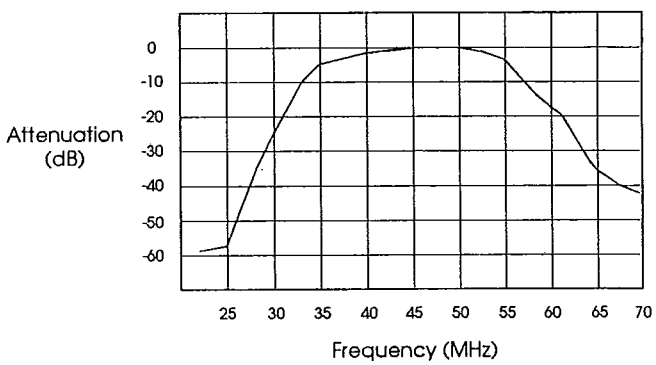

Figure 4 Low-Band FILTER RESPONSE

B. High Band (108 - 174 MHz)

1. Leave equipment connected as in Low Band Tuning procedure.

2. Set the R8/R8E to 168 MHz. Now the high band filters will be selected and their frequency response displayed on the analyzer.

3. Adjust the Trimmer caps in the two high band filters (C-182 and C-184) until the filter displays the desired response (as shown in Figure 5).

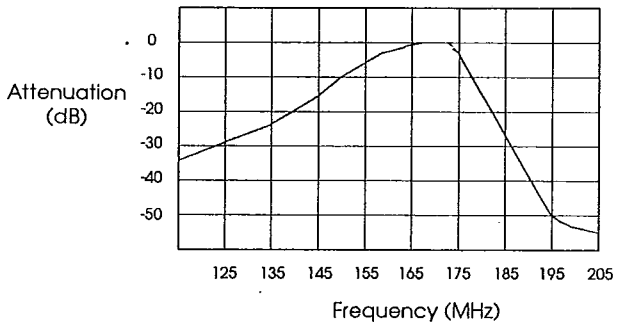

Figure 5 High-Band FILTER RESPONSE

4. Set the R8/R8E to 108 MHz and observe the filter response. It should be optimum without further adjustment.

Sensitivity and Microphonics Test

1. Install the converter in a R8/R8E Receiver. This must be done to eliminate electrical noise which would cause inaccurate results.

2. Measure 12dB SINAD at the following frequencies shown in the table using the setup shown in Figure 6. Make sure that the converter meets or exceeds the specification and that it is not microphonic at each frequency.

To check for microphonics, tap lightly on the VCO shield while noting that the recovered audio remains a clear 1 KHz tone.

R8/R8E Frequency	Sensitivity
45.123 MHz	Better than 12
115.234 MHz	dB SINAD
132.345 MHz	
145.456 MHz	
157.567 MHz	
168.678 MHz	

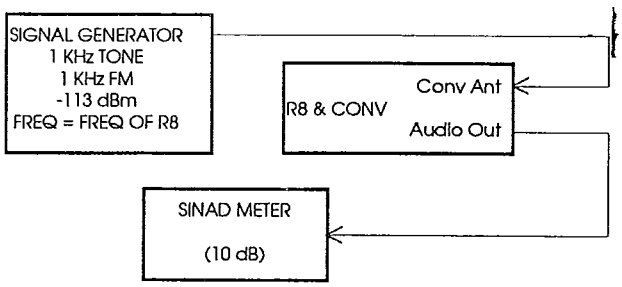

Figure 6 Sensitivity Test

R. L. DRAKE COMPANY
230 Industrial Drive
Franklin, Ohio 45005 U. S. A.
Customer Service and Parts Telephone 513-746-6990
Telefax 513-746-4683

VHF CONVERTER INSTALLATION INSTRUCTIONS

***CAUTION:* Refer installation to qualified service technician to prevent personal injury or damage to the equipment.**

Prior to starting installation of your new VHF converter, carefully unpack the converter PC board assembly and its associated cables and mounting hardware. You will need to use a Philips screwdriver during installation.
NOTE: A magnetized screwdriver facilitates the removal and installation of screws in the procedure that follows.

Identify the following items:
(1) #1001590 VHF Converter Assembly
(1) #3711160 Coaxial Cable, 8" Length
(1) #3711168 Coaxial Cable, 26" Length
(1) #2707293 6-Conductor Cable,17" Length
(1) #4350171 Retaining Bracket
(1) #3320244 Screw 4-40 x 1/4" Pan Head Philips

Install the VHF Converter assembly as follows:

DISCONNECT THE R8 RECEIVER FROM THE AC POWER SOURCE!

1) Remove the top cover from the R8 receiver by removing (5) #6-32 x 1/4" Pan Head Philips BLACK screws. Retain the cover and screws for reassembly.

2) Remove the bottom cover from the R8 receiver by removing (6) 4-40 x 1/4" Pan Head Philips screws. Retain the cover and screws for reassembly.

3) Identify the (6) conductor cable (17" length) and plug it onto the VHF converter assembly (Figure 1) being carefull to align the connector with the **RED** conductor on **Pin 1** of the VHF converter assembly.

4) Route the free end of the 6-conductor VHF converter cable vertically down behind front panel (near Volume Control) to the board assembly exposed by removal of bottom cover. See figure 2.

5) Position the VHF converter assembly into the chassis as illustrated (Figure 2). The board mounted components should face toward the outside edge of the R8 with the larger of the two component side shields toward the rear panel of the R8. Align the two tabs into the slots located on rear panel of the R8. Reposition any cables at rear panel, as necessary, to allow converter assembly to fit at the rear panel wall.

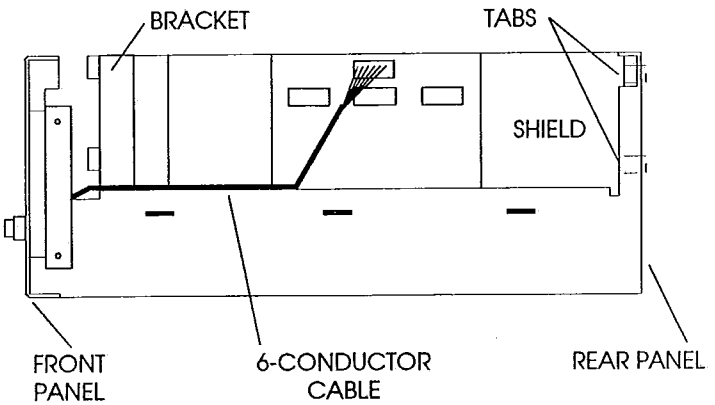

FIGURE 2 R8 SIDE VIEW

Locate the Retaining Bracket and position to edge of the VHF Converter assembly as shown. Use the supplied #4-40 x 1/4 Pan Head Philips screw to secure the bracket to the R8 chassis (Figure 3).

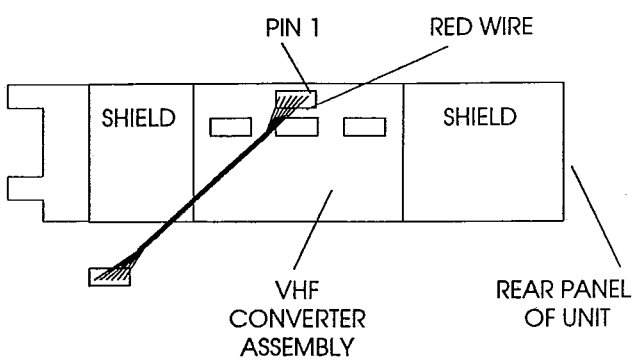

FIGURE 1

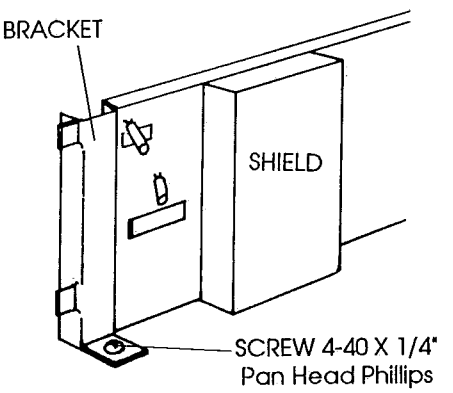

FIGURE 3

6) With the converter assembly now secured in the chassis with 6-conductor cable attached, position the R8 so it rests on its left-hand side (facing front of receiver). Locate the unconnected end of the 6-conductor cable and connect it to the synthesizer board connector in the orientation shown in Figure 4. Be careful to align the **RED** conductor on **Pin 1** of the synthesizer board assembly connector header. Position the cable assembly so that it routes as shown. Reduce any excess slack cable length near the VHF converter to provide the proper routing on its approach to the synthesizer board connector header.

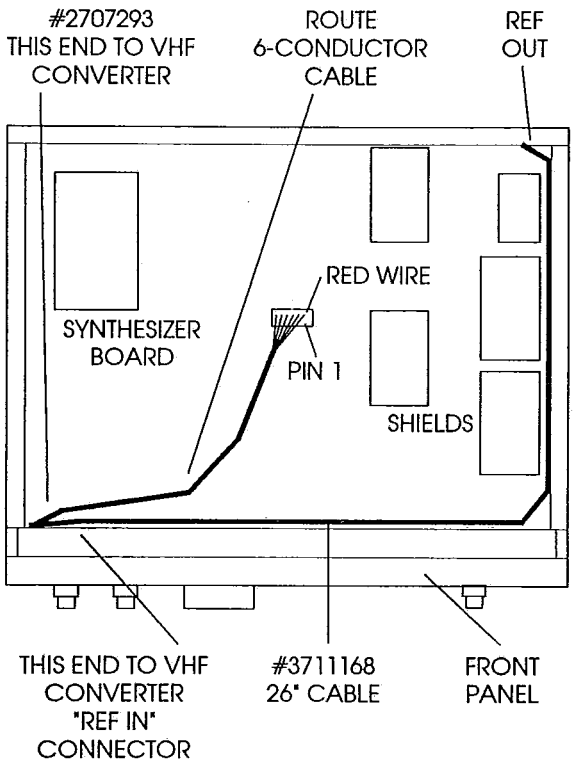

FIGURE 4 R8 BOTTOM VIEW

7) Connect the supplied 26" "REF" coaxial cable #3711168 to the 'REF OUT' connector located near the right rear corner of the synthesizer board. Position the cable as shown in Figure 4, routing the free end of the coax cable along the front panel (near volume control) and up to the VHF Converter assembly end nearest the front panel.

8) Position the R8 receiver so it rests on its bottom chassis with front panel facing towards you. Plug the unconnected end of the 26" 'REF' coaxial cable #3711168, into the "REF IN" connector located on the VHF converter assembly as shown in Figure 5.

9) Locate the factory installed coaxial cable connected to the rear panel "CONV" antenna input connector. Disconnect the terminal end of this coax from the Front End Board connector. Plug the coax cable into the 'RF IN' terminal of the VHF Converter as shown in Figure 5.

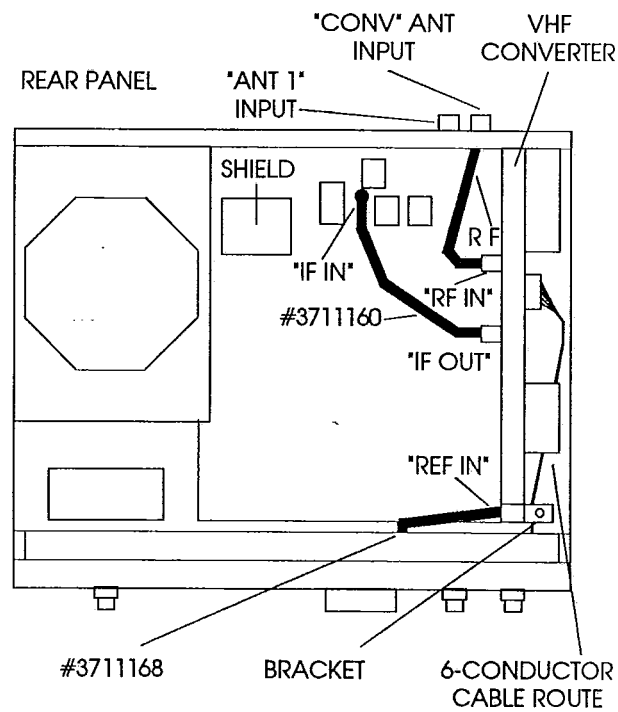

FIGURE 5 R8 TOP VIEW

10) Identify the 8" Coaxial Cable, #3711160. Plug in one end of the cable to the 'IF IN' terminal on the Front End board assembly and plug the other end into the 'IF OUT' terminal of the VHF Converter assembly.

The VHF Converter electrical installation is complete at this point. Prior to applying AC power to the R8 receiver for testing, proceed as follows:

11) Position the R8 with the bottom of the unit facing up, front panel toward you. Place the bottom cover on the unit oriented with the lever feet toward the front panel of the R8. Secure the bottom cover using (6) #4-40 x 1/4 " Pan Head Philips screws that were removed in step #2.

NOTE: You may wish to secure the bottom cover with (2) screws until after unit system check, but note that **AC power is active at all times in the R8 whenever it is connected to a source of AC power.**

12) Position the R8 with the top of the unit facing up, front panel towards you. Install the top cover using the (5) #6-32 x 1/4" Pan Head Philips BLACK screws retained in step #1.

UNIT SYSTEM CHECK

13) Connect the R8 to a source of AC power. Press the 'POWER' button to place the R8 in the 'ON' mode. The unit should automatically switch to the converter antenna input if any frequency in the range of either 35 - 55 MHz or 108 - 174 MHz is selected. (If the above action does not occur, check the 6-conductor cable assembly of the VHF converter). Once proper operation is noted, tune in a known active signal in either the range of 35 - 55 MHz or 108 - 174 MHz. Select the proper mode, bandwidth and other parameters as appropriate.

HINT: In many areas of the U.S., the NOAA weather stations are active on one of the following frequencies: 162.475 MHz, 162.550 MHz or 162.625 MHz. One of those or a similar type station could be tuned in as a convenient operational check.

Once correct operation is verified, disconnect the R8 from the AC Power Source. Secure the top and bottom covers with remaining screws if this has not already been completed in steps #11 and #12.

The R8 with VHF Converter is now ready for operation.

VHF OPERATION

Operation of the R8 in the VHF Bands of 35-55 MHz and 108-174 MHz is accomplished by entering the desired frequency directly as described on page 12 of the Owner's Manual, "DIRECT FREQUENCY ENTRY". Additionally, the R8 automatically will tune to the 35-55 MHz band followed by the 108-174 MHz band as the main tuning dial is tuned above 30 MHz. All reception modes are supported in the two VHF bands.

SPECIFICATIONS:	(Apply to the operation of the VHF Converter assembly installed in the R8 receiver)
Frequency Range	35-55 MHz 108-174 MHz
Antenna Impedance	50 ohms
Sensitivity: SSB, CW (+10dB S+N/N)	Less than 0.25 µV (2.3 KHz Bandwidth)
Sensitivity: AM (+10 dB S+N/N) (1 KHz, 30% mod)	Less than 1.0 µV
Sensitivity: FM (12 dB SINAD)	Less than 0.5 µV
Frequency Stability	Better than ±10 ppm, -10° to +50° C (determined by the R8 master reference oscillator)
Power Requirements	+10 VDC @ 150 mA
FCC Approval	Part 15 Certification
Weight	6.7 Oz. (0.2 Kg)
Size	Length 9-5/8" (24.4 cm) Width 2-1/2" (6.4 cm) Height 1-1/8" (2.9 cm)

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